

WHY WE NEED TO GO TO MARS

by Buzz Aldrin

**win!**

A \$1000  
**TELESCOPE**

p. 99

popularmechanics.com August 2009

# Popular Mechanics

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## The Truth About **Forensics**

Debunking the Shaky Science of  
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Fingerprinting  
& Other CSI Myths

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Foil ATM Scams  
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Portrait of Buzz Aldrin, Los Angeles, May 7, 2009. Photographed by Platon exclusively for POPULAR MECHANICS.

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## WHAT THEY'RE DOING



× SHAWN CARLSON

*Executive Director,  
SciTech Hands On Museum;  
MacArthur Fellow*

Shawn Carlson has been working on a broad roll-out of Labrats, a science scouting group for adolescents that he launched in 2006. In a related project, the founder of the Society for Amateur Scientists is developing an online community called I Do Science to give kids the structure and resources to discuss and conduct their own scientific research.

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**RICK SCHREINER**  
SAN MARINO, CA

**EDITOR'S NOTE:** You'll be happy to see "A Bolder Mission," by Apollo 11 astronaut Buzz Aldrin, on page 54 of this issue.

## NASA's Future

Tom Jones's "A Bolder NASA" seems to promote a gradual privatization of the space agency. One of NASA's advantages is its lack of influence and corruption from outside sources, which I believe commercial contractors would bring. I believe any involvement from the private sector should be analyzed for potential ramifications.

**JACKSON PEEBLES**  
SCHOOLCRAFT, MI

## Rebuilding America

Kudos on "Beyond the Buzzwords," with its infrastructure suggestions for the government's stimulus money. I hope President Obama is listening. We don't need 200-mph trains when we anticipate increased air travel and more fuel-efficient planes. We are flunking in the electric-vehicle department, but I hope that will change before it's too late.

**LLOYD WEAVER**  
HARPSWELL, ME

## PM LETTERS

### Space Exploration

Thank you for your June cover story "No Margin for Error: The Untold Story of Apollo 11." There was only one minor flaw—it was too short. It read like a hot novel. I couldn't put it down! Congratulations on an educational, enlightening and sometimes frightening flashback. You really told the bold truth about the vulnerability, intelligence, guts and heroism of the NASA mission staff, engineers and astronauts.

**GEORGE J. PULASKI**  
GRAND RAPIDS, MI

Your story on the Apollo 11 lunar landing is an exemplary article to mark the 40th anniversary of the event. Retelling this extraordinary chronicle in first person by the great Americans joined in this historic effort, coupled with the



Readers responded to an oral history of the Apollo 11 moon mission, a plan for NASA's future and infrastructure suggestions.

detailed illustration "Anatomy of a Moonshot," has yielded a most remarkable piece.

**HAL J. OIEN**  
BEAVERTON, OR

Whatever happened to our dream of exploring the universe? I look up at the moon and wonder when we'll go back. I look up at Mars and wonder whether we'll ever get there. Human exploration of both would bring pride and purpose to our space program. The Apollo 11 landing was a positive achievement for America, one that still stirs us to chase the stars. Let's keep the dream alive and make the

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### SUMMER TOYS

Kites with remote controls, water guns that take batteries and folding bikes with disc brakes—these are summer toys, PM-style. Our test team reviews the best and worst good-time contenders.

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# TechWatch

## Don't Scare the Sea Life

**Blue-green lasers** on the wingtips cast 100-foot beams that pilots use to spot obstructions without resorting to high-powered lights.

**Electronic components** are shielded to prevent the formation of electric fields, which would cause many animals to avoid the sub.

**Positive buoyancy** means the sub will float to safety if batteries or motors fail. It enables pilots to glide silently to the surface while searching for elusive sea creatures like the giant squid.

## Aquatic Acrobat

A NEW SUBMERSIBLE AIMS TO "FLY" RIDERS ON TOURS OF UNDERWATER SANCTUARIES.

→ **Graham Hawkes** has spent most of his life creating new ways to plumb the ocean's depths. Earlier this year he publicly unveiled his latest vehicle: a sleek, winged submersible dubbed the Deep Flight Super Falcon, which operates on principles of lift and drag, like an airplane. The craft, which should provide unprecedented subsea speed and maneuverability, will be used to ferry policymakers and others into the country's national marine sanctuaries. And the Super Falcon design is production-ready, so yachters and other wealthy nature lovers can buy their own. The price tag: about \$1.5 million. — MARK SCHROPE





## NEWS BRIEFS

Reports From the Edge of Science

Compiled by Alex Hutchinson

**Full-Circle Recycling** Talk about repurposing: Caterpillar is converting its abandoned buildings into engine parts. When the company decided to shut down a foundry in Peoria, Ill., it realized that recycling the steel in the structures would yield more money than selling the facility. The demolition teams use excavators with special grappling and shearing attachments to pull and hack apart the buildings. When completed, approximately 4000 tons of steel will be harvested to produce components for CAT's diesel engines. — KIMBERLY GRZYBALA

#### WORLD'S SMARTEST PROSTHETIC LIFTS VETS

✦ An Iraq veteran who lost both legs to a roadside bomb became the first patient to receive a new version of the **Power Knee**, a prosthetic that incorporates artificial intelligence to replace lost muscles. Developed by Icelandic company Ossur, the new prosthetic has quieter actuators that are controlled with input from ground sensors. A full commercial release of the new knee is planned for 2010.



#### FLEXIBLE AND FIREPROOF

✦ Firefighters need clothes that allow them to be agile, but if they're caught in the middle of a blaze, they want the thickest protection possible. DuPont has developed a flame-resistant



material that remains thin and flexible under normal conditions but **expands when the temperature exceeds 250 degrees F**. The added thickness provides up to 20 percent more thermal protection by trapping air within the fibers.

#### STEERING BEYOND THE SPEED OF SOUND

✦ When you're traveling at 10 times the speed of sound in a scramjet-powered aircraft, you can't afford to let the steering wheel wobble. Researchers at Ohio State University, in collaboration with the U.S. Air Force Research Laboratory, have developed a high-fidelity adaptive control system to pilot hypersonic vehicles. The system uses input from sensors to calculate necessary adjustments to keep an aircraft stable and on course. Research into hypersonic controls has increased since NASA's X-43A hypersonic jet reached Mach 9.6 in a 2004 flight. A possible milestone hypersonic flight of the Air Force's X-51A is scheduled for October.

#### THE COLOR OF IMPENDING FAILURE

✦ Researchers at the University of Illinois have developed a polymer that changes color when it becomes overstressed. Maintenance and safety workers will be alerted to structural weakness when chemical bonds inside the material break, altering its color. Possible uses include bridge supports, airplane wings and parachute cords.



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ABILIFY (aripiprazole) is a prescription medicine used as an add-on treatment to antidepressants for Major Depressive Disorder in adults.

### What is depression?

Depression is a common but serious medical condition. Symptoms may include sadness, loss of interest in activities you once enjoyed, loss of energy, difficulty concentrating or making decisions, feelings of worthlessness or excessive guilt, insomnia or excessive sleep, a change in appetite causing weight loss or gain, or thoughts of death or suicide. These could be depression symptoms if they interfere with daily life at home, at work, or with friends and last most of the day, nearly every day for at least 2 weeks.

### What is the most important information that I should know about antidepressant medicines, depression, and other serious mental illnesses?

- Antidepressant medicines may increase suicidal thoughts or actions in some children, teenagers, and young adults
- Depression and serious mental illnesses are the most important causes of suicidal thoughts and actions

For more information, see the Prescribing Information and the Medication Guide called *Antidepressant Medicines, Depression and Other Serious Mental Illnesses, and Suicidal Thoughts or Actions*.

### Who should NOT take ABILIFY?

People who are allergic to ABILIFY or to any substance that is in it. Allergic reactions have ranged from rash, hives and itching to difficulty breathing and swelling of the face, lips, or tongue. Please talk with your healthcare professional.

### What is the most important information that I should know about ABILIFY?

**Elderly patients, diagnosed with psychosis as a result of dementia (for example, an inability to perform daily activities as a result of increased memory loss), and who are treated with antipsychotic medicines including ABILIFY, are at an increased risk of death when compared to patients who are treated with a placebo (sugar pill). ABILIFY is not approved for the treatment of patients with dementia-related psychosis.**

Antidepressants may increase suicidal thoughts or behaviors in some children, teenagers, and young adults, especially within the first few months of treatment or when the dose is changed. Depression and other serious mental illnesses are themselves associated with an increase in the risk of suicide. Patients on antidepressants and their families or caregivers should watch for new or worsening depression symptoms, unusual changes in behavior, or thoughts of suicide. Such symptoms should be reported to the patient's healthcare professional right away, especially if they are severe or occur suddenly. ABILIFY is not approved for use in pediatric patients with depression.

Serious side effects can occur with any antipsychotic medicine, including ABILIFY. Tell your healthcare professional right away if you have any conditions or side effects, including the following:

**Stroke or ministroke in elderly patients with dementia:** An increased risk of stroke and ministroke has been reported in clinical studies of elderly patients with dementia (for example, increased memory loss and inability to perform daily activities). ABILIFY is not approved for treating patients with dementia.

**Neuroleptic malignant syndrome (NMS):** Very high fever, rigid muscles, shaking, confusion, sweating, or increased heart rate and blood pressure may be signs of NMS, a rare but serious side effect that could be fatal.

**Tardive dyskinesia (TD):** Abnormal or uncontrollable movements of face, tongue, or other parts of body may be signs of a serious condition known as TD, which may be permanent.

**High blood sugar and diabetes:** Patients with diabetes and those having risk factors for diabetes (for example, obesity, family history of diabetes), as well as those with symptoms such as unexpected increases in thirst, urination, or hunger should have their blood sugar levels checked before and during treatment. Increases in blood sugar levels (hyperglycemia), in some cases serious and associated with coma or death, have been reported in patients taking ABILIFY, and medicines like it.

**Orthostatic hypotension:** Lightheadedness or faintness caused by a sudden change in heart rate and blood pressure when rising too quickly from a sitting or lying position (orthostatic hypotension) has been reported with ABILIFY.

**Suicidal thoughts:** If you have suicidal thoughts, you should tell your healthcare professional right away.

**Dysphagia:** Medicines like ABILIFY have been associated with swallowing problems (dysphagia). If you had or have swallowing problems, you should tell your healthcare professional.

### What should I talk to my healthcare provider about?

Patients and their families or caregivers should watch for new or worsening depression symptoms, unusual changes in behavior and thoughts of suicide, as well as for anxiety, agitation, panic attacks, difficulty sleeping, irritability, hostility, aggressiveness, impulsivity, restlessness, or extreme hyperactivity. Call your healthcare provider right away if you have thoughts of suicide or if any of these symptoms are severe or occur suddenly. Be especially observant within the first few months of antidepressant treatment or whenever there is a change in dose.

Tell your healthcare provider about any medical conditions you may have and all medicines that you are taking or plan to take, including prescription and nonprescription (over-the-counter) medicines.

### Be sure to tell your healthcare provider:

- If you have suicidal thoughts
- If you or anyone in your family have or had seizures
- If you or anyone in your family have or had high blood sugar or diabetes
- If you are pregnant, plan to become pregnant, or are breast-feeding

### What should I avoid when taking ABILIFY (aripiprazole)?

- Avoid overheating and dehydration
- Avoid driving or operating hazardous machinery until you know how ABILIFY affects you
- Avoid drinking alcohol
- Avoid breast-feeding an infant

### What are the possible side effects of ABILIFY?

Common side effects in adults include: nausea, vomiting, constipation, headache, dizziness, an inner sense of restlessness or need to move (akathisia), anxiety and insomnia.

It is important to contact your healthcare professional if you experience prolonged, abnormal muscle spasm or contraction which may be signs of a condition called dystonia.

### What percentage of people stopped taking ABILIFY due to side effects?

In clinical trials, the percentage of adults who discontinued taking ABILIFY due to side effects was ABILIFY (6%) and for patients treated with sugar pill (2%).

### Can I safely take ABILIFY while I'm taking other medications?

ABILIFY can be taken with most drugs; however, taking ABILIFY with some medicines may require your healthcare professional to adjust the dosage of ABILIFY.

Some medicines\* include:

- ketoconazole (NIZORAL®)
- quinidine (QUINIDEX®)
- fluoxetine (PROZAC®)
- paroxetine (PAXIL®)
- carbamazepine (TEGRETOL®)

It is important to tell your healthcare professional about all the medicines you're taking, just to be sure.

### General advice about ABILIFY:

- ABILIFY is usually taken once a day, with or without food
- ABILIFY should be kept out of the reach of children and pets
- Store ABILIFY Tablets and the Oral Solution at room temperature
- For patients who must limit their sugar intake, be aware that **ABILIFY Oral Solution contains sugar**
- For patients who cannot metabolize phenylalanine (those with phenylketonuria or PKU), **ABILIFY DISCMELT® contains phenylalanine**
- If you have additional questions, talk to your healthcare professional

### Find out more about ABILIFY:

Additional information can be found at [www.abilify.com](http://www.abilify.com)

\* NIZORAL is a registered trademark of Janssen Pharmaceutica; QUINIDEX is a registered trademark of Wyeth Pharmaceuticals; PROZAC is a registered trademark of Eli Lilly and Company; PAXIL is a registered trademark of GlaxoSmithKline; TEGRETOL is a registered trademark of Novartis Pharmaceuticals.

Based on Full Prescribing Information as of 05/08 1239550A2.

Bristol-Myers Squibb Otsuka Otsuka America Pharmaceutical, Inc.

Tablets manufactured by Otsuka Pharmaceutical Co., Ltd., Tokyo, 101-8535 Japan or Bristol-Myers Squibb Company, Princeton, NJ 08543 USA.  
Orally Disintegrating Tablets, Oral Solution, and Injection manufactured by Bristol-Myers Squibb Company, Princeton, NJ 08543 USA.  
Distributed and marketed by Otsuka America Pharmaceutical, Inc., Rockville, MD 20850 USA.  
Marketed by Bristol-Myers Squibb Company, Princeton, NJ 08543 USA.  
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# Shoestring Space Race

THE N-PRIZE CHALLENGE: LAUNCH A SATELLITE INTO ORBIT FOR THE COST OF A MACBOOK. BY MICHAEL BELFIORE

→ The cost of the cheapest-ever satellite launch stands at more than \$200,000. So is it possible to send an object into orbit for the cost of a new laptop? That's the goal behind the N-Prize, a contest organized by U.K. molecular biologist Paul Dear. The winner will have to launch an object weighing about 0.35 to 0.7 ounces into space for less than \$1500. The satellite will then have to stay up for at least nine orbits to win the \$15,000 prize. Dear says the challenge is "just on the edge of feasibility," but he's confident that someone will win by

the late 2011 deadline. Karl Siebold, an aerospace engineering professor at Embry-Riddle Aeronautical University in Arizona, won't call the contest impossible, but says he can't imagine how it could be won. The biggest challenge: Once a satellite reaches space, it needs to decelerate and be nudged into orbit. This typically requires expensive guidance systems and multiple rocket stages. Undaunted, 18 competitors have signed up. "Their approaches range from the ingenious to the wacky," Dear says. "But I think we need more lunatics in this business."

## A LOOK AT THREE TEAMS COMPETING FOR THE N-PRIZE

### Nebula Aerospace

→ British electronics engineer Peter Jones, with help from his family, plans to launch four satellites at a time on a liquid-fuel rocket powered by an experimental



engine that eliminates the traditional bell-shaped nozzle. The team has constructed a motorized ground antenna (above) with a high-gain dish and helical antenna.

### Cambridge University Spaceflight

→ Engineering students at Cambridge University are using balloons to send teddy bear "astronauts"—yes, that's a photo (above right)—to



heights of greater than 18 miles. Next they'll attach solid-fuel rockets to the balloons and launch payloads into space from high altitudes.

### Microlaunchers

California-based electronics engineer Charles Pooley plans on using a three-stage liquid-fuel rocket to launch a cellphone-component-based transmitter into orbit, powered by a 6-gram battery.

N-Prize competitors at Cambridge University launch a rocket in March that will ultimately reach about Mach 1 (760 mph) on its trip to just under 9000 feet.

## Bubble Wrap

NEW TOUCHSCREENS USE AIR BUBBLES THAT POP UP PHYSICAL BUTTONS. BY JENNIFER WRIGHT

Touchscreens allow for endlessly adjustable interfaces—well, nearly endless. You can't operate a touchscreen by feel alone, although engineers working in the field of haptics have used vibrating virtual buttons to provide limited tactile feedback. Now, researchers at Carnegie Mellon University have gone a bit further, designing a screen with hidden latex air bubbles. When buttons are needed, an air pump pops the bubbles into physical keys. The team tested the technology in a driving simulator, a situation where users don't—and shouldn't—devote full attention to electronic displays on GPS and audio systems. "There were only a quarter as many glances away from the road as there were with the touchscreen," Chris Harrison, a graduate student at CMU who worked on the project, says. Volkswagen is interested in the buttons, according to the researchers. And the technology could eventually find its way into Braille-enabled gadgets.



DEFLATED BUTTONS



INFLATED BUTTONS



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## Explosive Cinema

FILMING *THE HURT LOCKER*  
PROVES IT ISN'T EASY TO  
ACT IN A BOMBPROOF SUIT.  
BY ERIN MCCARTHY

TECH WATCH

➔ Even though improvised explosive devices (IEDs) are the trademark weapon of the Iraqi and Afghan insurgencies, the experiences of those tasked with defusing them are not well-known. Their stories are what prompted director Kathryn Bigelow to film *The Hurt Locker*, a fictional account of an Explosive Ordnance Disposal (EOD) team at the end of its 2004 rotation through Iraq. Bigelow shot the movie with as many as four handheld cameras at a time, which she says boosted the film's realism. "You're actually

performing a bomb disarmament from beginning to end, and the cameras are there capturing it," she says. Bigelow also sent the film's actors to the Army National Training Center at Fort Irwin, Calif., to train in the gear used by EOD teams, including a 90-pound Kevlar polymer bomb suit that team leaders wear when they defuse IEDs. Even experts find the suits challenging. "Any time you put on something with a face mask, you get 10 percent stupider," says Capt. Robert Busseau, EOD Operations Officer for 20th Support Command. "But we want somebody who still responds intelligently when they're tired." At Fort Irwin, the actors got a taste of the intense training that EOD teams receive, which Busseau says washes out 20 percent of applicants. Actor Jeremy Renner, who plays an EOD team leader, says the mental stress of working in the suit rivals the physical discomfort: "EOD is all about how mentally tough you are."



Actor Jeremy Renner wore a 90-pound bomb suit while filming in Jordan during the summer, when temperatures regularly reach 125 F. "At least once I got the suit on," he says, "I knew I wasn't going to get any hotter."



ON THE WEB > Read interviews with the director and cast of *The Hurt Locker* and EOD team members at [popularmechanics.com](http://popularmechanics.com).





**Raja Parasuraman**  
George Mason University

"Ninety percent of neuroscience work has been done on animals. The techniques are all invasive and cannot be used on humans. But in the last 20 years we've developed noninvasive techniques to study human brain functions."



George Mason graduate student John Fedota takes the kind of memory test that helped identify Subject 7 at Parasuraman's lab.

## The Strange Case of Subject 7

WHAT IS A COGNITIVE SUPERSTAR? ONE GRAD STUDENT'S EXCEPTIONAL BRAIN COULD HELP SETTLE THE DEBATE OF NATURE VERSUS NURTURE.  
BY JOE PAPPALARDO

→ Last year, Raja Parasuraman was conducting a study of brain function among 650 participants at George Mason University in Virginia, when he stumbled across what he calls a "cognitive superstar." The university professor studies neuroergonomics—a merger of neuroscience, the study of the brain, with ergonomics, the study of how to design systems and technologies to be more compatible with

users. Parasuraman hooks subjects to MRI, EEG and other brain scanners while conducting memory and attention tests to see what parts of the brain activate. During one test, a 26-year-old grad student, identified only as Subject 7, proved his astonishing ability to concentrate—acing hours of memory and cognition tests that humbled his competitors. "[Finding S7] has interested me in the issue of the genetic and training contributions to expertise," Parasuraman says. For example, some studies show that people who spend a lot of time playing video games can increase their attention capacity. S7 is not an avid gamer, so Parasuraman was pleased to find a genetic root for his abilities: S7's DNA has a variation that correlates to short-term memory. The researcher is now conducting deeper studies into the biological influences on aptitude. "The nature versus nurture debate has dissolved into a question of relative contributions," Parasuraman says. "We know they interact, but we can now identify the nature part in more detail."

THE KEY TO THE  
BATTERY-POWERED  
HOUSE



When scaled up in size, this prototype battery could store enough energy to power a house for most of a day.

→ Without a way to store their power, no number of solar panels will free a home from the electrical grid. Researchers at Utah-based Ceramtec have developed a new battery that can be scaled up to store 20 kilowatt-hours—enough to power an average home for most of a day. An easy sell for solar users, but it could also allow the grid-bound to stockpile energy during less

expensive off-peak hours.

The new battery runs on sodium-sulfur—a composition that typically operates at greater than 600 F. "Sodium-sulfur is more energetic than lead-acid, so if you can somehow get it to a lower temperature, it would be valuable for residential use," Ralph Brodd, an independent energy conversion consultant, says.

Ceramtec's new battery runs at less than 200 F. The secret is a thin ceramic membrane that is sandwiched between the sodium and sulfur. Only positive sodium ions can pass through, leaving electrons to create a useful electrical current. Ceramtec says that batteries will be ready for market testing in 2011, and will sell for about \$2000. — RANDY WRIGHT





**CONFIGURATION 1:**  
Launch, re-entry, emergency  
extra-vehicular activity

**One Spacesuit,  
Two Ways to Use It**

**Helmets**

The visor on Configuration 2 (right) will be angled further forward to allow for greater downward visibility.

**Life Support**

An umbilical connection will provide Configuration 1 with oxygen, thermal control and communications. Configuration 2 will have a backpack-based portable life-support system (PLSS).

**Torso and Limbs**

Configuration 1's torso and limbs are designed for comfort and mobility over a long period aboard a spaceship or space station. Configuration 2 can be mounted with a PLSS, and is designed to make long-distance walking on the surface of the moon as easy as possible.

**Gloves**

Configuration 1's gloves are lighter and designed for greater dexterity. Configuration 2's aren't as nimble, but offer more tear- and puncture-resistance.

**Outer Layer**

Configuration 1's outer layer is fire-retardant; Configuration 2's is tough enough to withstand space debris.



**CONFIGURATION 2:**  
Extra-vehicular activity, future  
missions to the moon and Mars

## A Spacesuit for All Missions

NASA'S NEW MODULAR SPACESUIT WILL HANDLE ANY MISSION. BY MORGAN LORD

➔ **Today's astronauts** use spacesuits that have remained essentially the same since 1983. Now, their gear is getting a makeover. NASA has awarded a contract to Oceaneering International to begin developing the Constellation Space Suit System (CSSS). For the first time, a single modular spacesuit will be able to handle an astronaut's entire workload. The CSSS will have two primary configurations: one for launch, re-entry and emergency extra-vehicular activity (EVA); and a second for routine EVAs, walking on the moon and, eventually, undertaking missions to Mars. Compared to the old system, in which astronauts often required multiple suits for one mission, the CSSS will be lighter and potentially cheaper. The first configuration is scheduled to debut in time for the Orion missions in 2015, the second for the planned return to the moon in 2020.



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- 1900 ● The first "hybrid" electric car is created with electric drive motors built into the front wheels
- 1920s ● Biofuels make up 25% of all fuel sales
- 1964 ● BRUT® makes its national debut ensuring that men everywhere have an alternative way to protect their environment
- TODAY ● BRUT® introduces 24-Hour Protection with Trimax® Anti-Perspirant and Deodorant for extreme protection against odor and wetness – no matter what fuels you



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# Upgrade



The included 35-dart drum magazine can be snapped on to a number of other Nerf blasters.

## Soft Power

Choosing a Nerf gun is all about finding the right balance between firepower and mobility. The biggest Nerf blasters fire a battery-augmented, fully automatic stream of foam, but they jam easily and are too heavy for fast-moving assaults. The **Nerf N-Strike Raider Rapid Fire CS-35 (\$35)** gets it right. It's light enough to sneak shots around corners and its pneumatic pump allows you to blast multiple darts at once. But the best part is that this gun pretty much guarantees you'll be the last man standing: It holds more ammo than any Nerf gun ever, thanks to a snap-on 35-dart drum magazine. — *SETH PORGES*





## Sheetrock Slicer

The traditional score-and-snap method of cutting drywall involves making multiple cuts before manually snapping the sheet. The **Goldblatt Blade Runner** (\$70) procedure: Place the two halves of the device on either side of any drywall up to  $\frac{5}{8}$  inch thick. The pieces stay in sync thanks to powerful magnets, and both sides are equipped with circular blades. As you pull one component of the device along the drywall, the other piece is drawn along in tandem. The blades cut from both sides of the drywall at once, producing the quickest, most precise cuts we've ever seen.



## Shrunkn Shooter

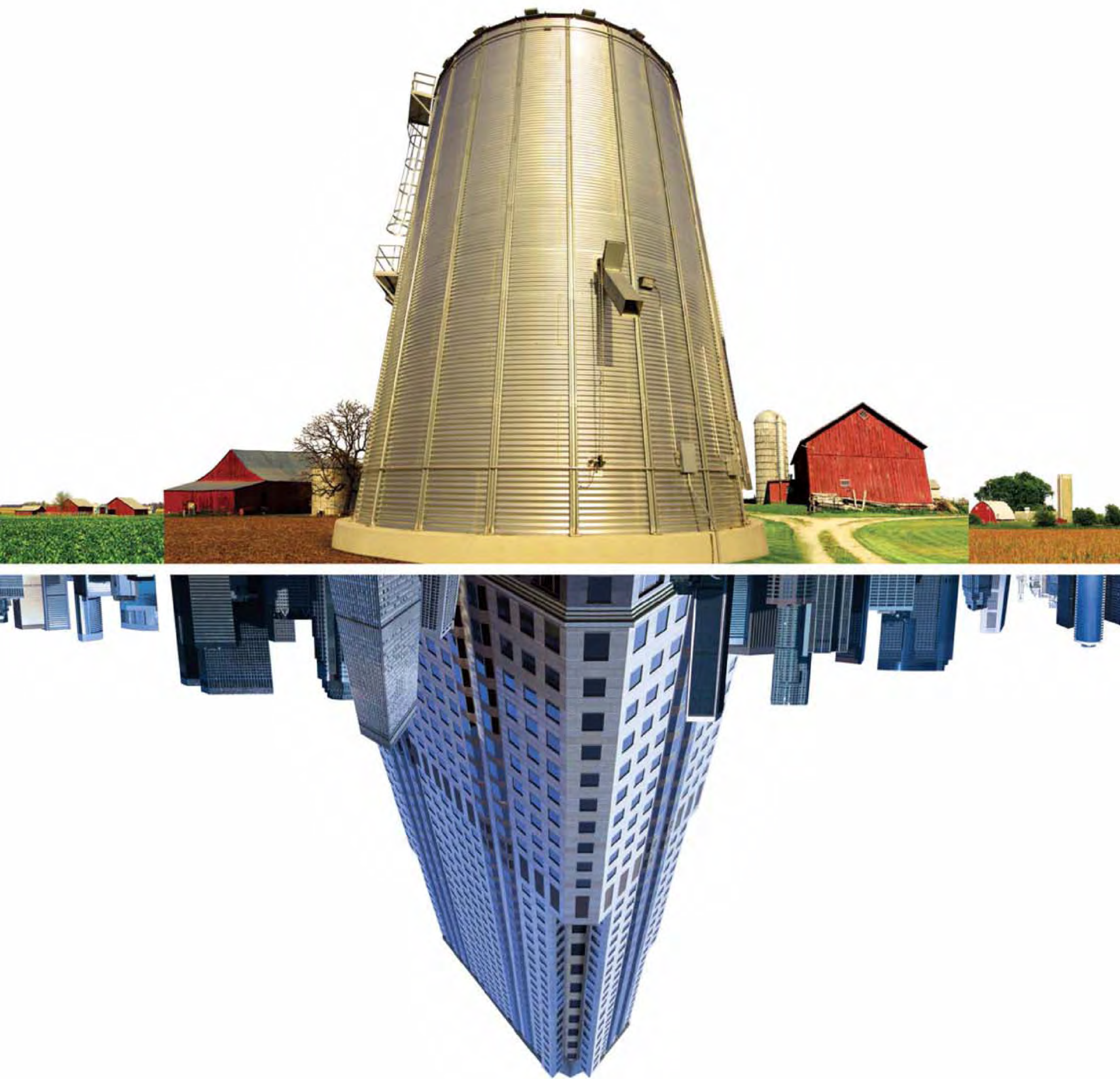
If you cracked open the **Nikon D5000** (\$850 with lens) and the company's D90, you'd be hard-pressed to tell the two digital SLR cameras apart. They feature the same 12.3-megapixel sensor, the same ability to shoot high-def video and a virtually identical spec sheet. But the D5000 is \$300 cheaper, features a swiveling LCD and is significantly lighter than the D90. So what gives? The D5000 has a slightly lower-res LCD and is missing a few features that are rarely used by non-pros. That's a tradeoff we'll take.



## Beyond Level

The classic spirit level has been a toolbox mainstay for centuries, relying on the simple downward pull of gravity to finger slanted surfaces with black-and-white precision. The **C.H. Hanson 24-Inch Precision Ball Level** (\$40) expands the idea by ditching floating bubbles for a multidirectional ball similar to the ones used in airplanes to find the horizon line. The resulting tool measures plumb and level, but it also reveals precise angles, including compound angles, easily providing measurements in three dimensions.





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## Abusive Lab Test

RUGGEDIZED CELLPHONES

**Ruggedized cellphones** are typically designed to comply with Military Specification 810F, able to withstand light shocks, short falls and splashes. But just how far can they go? We took three and pushed them way beyond their spec sheet to approximate real-life mishaps—if real life was a demolition derby run by Navy SEALs. For the phones, it proved to be a one-way trip to PM's lab.

BY SETH PORGES

the tests



the phones



### DROP IT

Using a ladder, we repeatedly dropped the phones from a height of 8 feet.

### ➤ DROWN IT

We tossed the phones into a toilet, fished them out, then repeated—a total of 10 times.

### SMASH IT

We laced up heavy-duty work boots and stomped on each phone 10 times.

### BOTTOM LINE

The Sonim looked and felt the toughest, but the Verizon G'zOne Boulder was the winner—it continued to work until it was literally a tangle of plastic shards and wires.

#### 1. **Motorola Tundra VA76r** (\$200 with two-year contract)

We dropped it again and again, but the Tundra continued to be in call-ready condition.

+

The Tundra survived a few quick swims. But after the fifth fall, a hard hit on the porcelain bowl caused it to spring a leak. The water killed the phone.

+

The Tundra's hinge busted after one hard stomp from the business end of a boot. After the second smash, it was lights out for the Motorola.

#### 2. **Sonim XP3** (\$500 unlocked)

The bricklike Sonim survived repeated falls, damage- and ding-free. Its rubberized surface even caused it to bounce like a SuperBall.

+

The Sonim's seams are coated with a watertight array of gaskets and seals, all of which held up to repeated dunks.

+

The phone *looked* fine. But after eight stomps, the Sonim simply stopped working. Our guess: An interior circuit got nudged loose.

#### 3. **Verizon G'zOne Boulder** (\$130 with two-year contract)

Despite its clamshell design (which presents an obvious weak point—its hinge) the Boulder shrugged off falls to the floor.

+

The water was no match for this water-resistant phone, which held up to multiple plunges in the privy.

+

We stomped on it. We jumped on it. Finally, we broke out the baseball bat—and even then it took three swings to turn our winner into a tangle of wires.

WINNER!



**ON THE WEB** ➤ For this Abusive Lab Test, PM teamed up with Josh Zepps (in black), host of the Science Channel's *Brink*, for an episode to air this summer. You can see the test video at [popularmechanics.com/abusivelabtest](http://popularmechanics.com/abusivelabtest).



# U.S. GOV'T GOLD AT-COST

**TODAY - The United States Rare Coin & Bullion Reserve has scheduled the final release of U.S. Gov't Issued \$5 Gold Coins previously held at The U.S. Mint at West Point. These Gov't Issued Gold Coins are being released on a first-come, first-serve basis, for the incredible markup-free price of \$124 each. This "at-cost" Gov't Gold offer could be canceled at any time. Do not delay. Call a Sr. Gold Specialist today.**

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Coins enlarged to show detail.



## Disaster Prep

U P G R A D E  
P M

**HOME** For millions of Americans living along the Gulf and Atlantic coastlines, hurricane season is an annual call to arms, a six-month stretch from June through November spent watching the skies and the local news for signs of trouble. Other regions cope with the threat of wildfires, quakes and tornadoes—and blackouts can strike anywhere. While no season is safe from disruption, late summer seems particularly inviting to the demons of disaster. Here's a step-by-step guide to preparing your home and family.

BY ERIK SOFGE



### • power

A properly equipped homeowner can survive without electricity. But having a backup generator can make the experience a lot more tolerable—if you have the know-how to use it correctly.

#### • do the math

Add up the wattage of all the devices you want to run off the generator, as well as the total surge wattage (the spike in power demand caused by some high-wattage appliances), and buy a generator whose output can handle those totals. For example, the 2800-watt (3000 surge watts) **Honda EU 3000iSA** (\$2000) should provide enough power to light seven 60-watt bulbs (420 watts), a full-size refrigerator (725 watts, 1600 surge watts), a fan (200 watts) and a microwave (750 watts). If you think you'll need more power, buy a larger generator.

#### • keep it outside

Carbon-monoxide-spewing generators can turn your house into a deathtrap. Always position a generator at least 10 feet from the house in an unenclosed space before turning it on.

#### • know when to call the pros

Improperly plugging a generator into your home wiring is dangerous. For a full-scale power supply, hire an electrician to install a transfer switch, or buy a permanent backup generator system.



### • safety

Larger fire extinguishers with higher UL ratings can tackle more surface area. At the minimalist end of the spectrum, the 9.65-inch-long, 22-ounce **First Alert Tundra extinguisher** (\$30) is compact and light enough to fit into a box of disaster supplies or a drawer, and is powerful enough to handle small flare-ups.

First-aid kits also come in a variety of sizes, but the **Red Cross Family First Aid Kit** (\$20) stocks more than enough supplies to treat minor cuts and burns.



### • communication

If the power goes out, so does the Weather Channel. An NOAA radio provides constant weather alerts from the National Weather Service. Simple hand-cranked models cost as little as \$30, but for long-term emergencies, **Eton's FR600 Solarlink** (\$80) is a better choice. It can also run on sunlight, has built-in LED lights and can be used to charge cellphones. And make sure everybody's wallet has a printed list of family contact information, including a point person at least 50 miles away who can coordinate communication in case local telecommunications are down.

→ the gear



Honda EU 3000iSA Generator



First Alert Tundra Extinguisher



Red Cross Family First Aid Kit



Eton FR600 Solarlink NOAA Radio





TROUBLE HEADING YOUR WAY?  
HERE'S WHAT YOU NEED TO KNOW



WILDFIRES / TORNADOES / HURRICANES / METEORITES



## • evacuation

Your home may be a fortress, but it doesn't have to be the Alamo. Knowing how to retreat is a key component of disaster preparedness.

GRAB A BAG	BRING YOUR PAPERWORK	GET IN THE CAR
<p>↓</p> <p>If a quick getaway is called for, you won't have time to pack. Prepare a bag with essential supplies, and keep it by your front door. It should include: a prepaid phone card, matches (either waterproof or in a waterproof container), a</p>	<p>↓</p> <p>flashlight, an NOAA radio, batteries, food, an emergency whistle, extra keys for your home and car, prescription medications, a first-aid kit, \$300 in small denominations and diapers and formula or other necessities for any children.</p>	<p>↓</p> <p>Prepack the following documents in a sealed Ziploc bag, and keep it stashed in your grab-and-go bag: bank records, copies of deeds, insurance policies, personal identification and medical records.</p>
		<p>If a disaster is coming, fill up your gas tank. A power inverter allows you to use AC plugs in your cigarette-lighter jack. A 100-watt model such as the <b>Black &amp; Decker 100 Watt Power Inverter</b> (\$30) should do.</p>

## • water

You'll need a gallon of clean drinking water per person, per day. If you're expecting a long haul, load up the **WaterBOB** (\$30). This bathtub-filling bladder hooks up to your faucet and holds up to 100 gallons of water, in case the local water supply is compromised. You can also keep a backup filter on hand—the **Aquamira Frontier Pro** (\$25) acts like a germ-killing straw, eliminating bacteria in up to 50 gallons of water. A special adaptor lets you attach the filter to a water heater, which holds as much as 30 gallons of additional water.

## • shutting down your house

If heavy flooding is imminent, turning off your electricity and water—to avoid contamination as sewers and other systems overflow, and to prevent a submerged basement from becoming electrified—is a risk-reducing procedure. Natural gas, on the other hand, should only be shut off when authorities advise it. Although a simple wrench or pliers will adjust most gas and water valves, the **On Duty 4-in-1 Emergency Tool** (\$17) is designed to quickly handle both. If you do turn off the gas, never turn it back on yourself—your utility company has a better chance of spotting damaged lines.



Black & Decker 100 Watt Power Inverter



WaterBOB Bathtub Bladder



Aquamira Frontier Pro Water Filter



On Duty 4-in-1 Emergency Tool





✓Yes



✓Yes



✓Yes



✓Yes



✓Yes



xNo



✓Yes



✓Yes



✓Yes

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# New Cars



## Transformer

pm test driven

2010 **Ford Taurus**

Base Price: \$31,995  
*Limited Model*

**Ford allowed its best-selling Taurus** to slip into mediocrity. But thanks to renewed focus on quality, Ford—the only domestic automaker to avoid bankruptcy—has created a rather exceptional new Taurus. The sheet metal is crisper, the interior is fitted with better materials, and the driving experience is vastly improved. Don't expect pavement-eating thrust from the 263-hp 3.5-liter V6—that will come in the Taurus SHO. Yet few sedans in this class are so well-mannered—front-drive torque steer is nearly banished. The Taurus certainly feels big—there's no hiding 2 tons—and there's an almost Germanic solidity to this car. The ride is compliant, and the steering wheel rotates with precision. The Taurus is so quiet, road impacts are barely audible. We enjoyed the leather-clad Limited, but even the cloth seats are comfortable. Best of all, the rear seats fit full-size adults. And luxury-spec tech like adaptive cruise control and blind-spot monitoring means the Taurus could be back on top. —LARRY WEBSTER

### INSIDE:

- + Suzuki GSX-R1000 | Lexus IS 250/350 Convertible
- + Lincoln MKT | Mercedes-Benz E-Class Coupe | Zero S | BMW Z4



+  
PM TEST  
DRIVEN  
+→ Ford Taurus | Suzuki GSX-R1000 | Lexus IS 250/350 Convertible |  
Lincoln MKT | Mercedes-Benz E-Class Coupe | Zero S | BMW Z4 X

① 2010 Suzuki GSX-R1000

② 2010 Lexus IS 250/350 Convertible

## Velvet Hammer

It's tempting to think that ever-increasing levels of motorcycle performance will tend to produce greater compromises in comfort and ease of use. But the new \$12,899 GSX-R1000 suggests otherwise. The big Gixxer is all new, and there's a fully revised 999-cc four-cylinder that packs 155 hp. The GSX-R needs no more than 5000 rpm to make traffic drop away in the mirrors like coins down a well. It takes real resolve to hold full throttle to the 13,500-rpm redline. Yes, it's insanely quick. The irony here is that the new GSX-R1000 is a real pussycat in town. There's enough low-end grunt to toddle around the suburbs. Of course you'd need a pro license to fully tap this bike's potential. But it won't bite you unless it's provoked. —BARRY WINFIELD

*The GSX-R1000 may be tame around town compared to previous models, but this is still a serious machine. Suzuki kept die-hard track junkies in mind by redesigning the engine's valvetrain with larger titanium valves throughout to allow race teams more leeway when prepping for competition.*

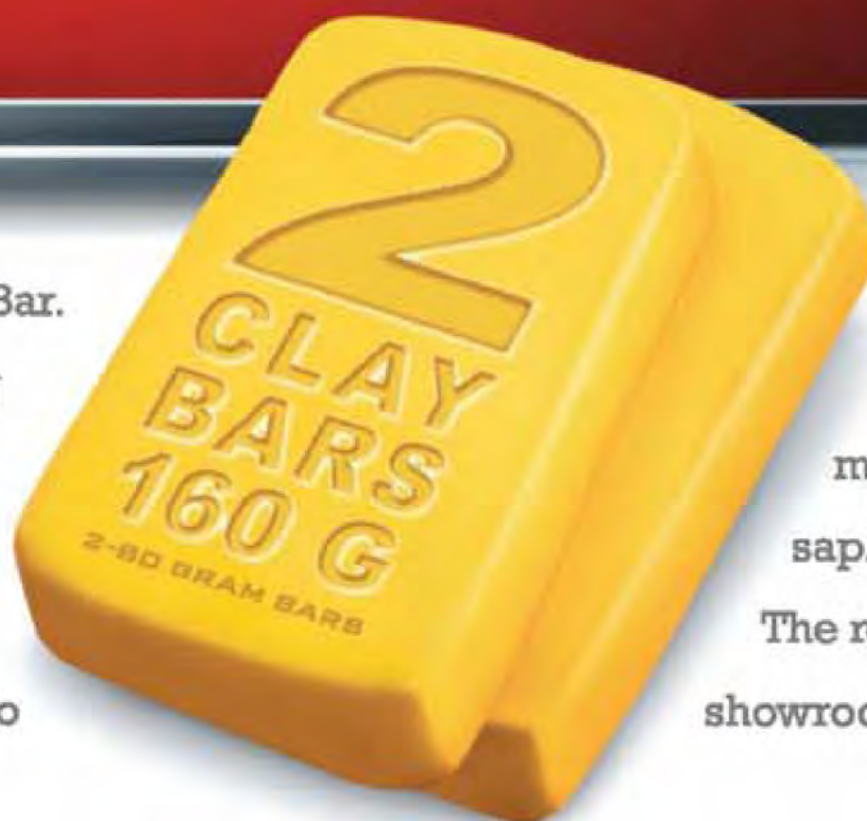
## Summer Cruise

Lexus is matching its lineup with those talented techs in Bavaria. In this case, the new droptop squares off against the BMW 3 Series convertible. The three-panel hardtop performs a ballet of mechanical wizardry in about 20 seconds. Despite the aesthetic similarities, the only thing the IS convertibles actually share with their four-door brethren is a hood. The \$38,490 IS 250 C is powered by a 204-hp 2.5-liter V6. Unfortunately, lugging around the extra 380 pounds from the hardtop is a little too much to ask of this engine. Fear not—Lexus offers the \$43,940 IS 350 C with a 306-hp 3.5-liter direct-injection V6. It hustles to 60 mph in 5.8 seconds. Inside, both cars automatically adjust the a/c and audio to handle temperature and wind-noise variations. There's a surprising amount of room in the back seat for real adults, too. —JAMES TATE



# Advanced friction technology. Didn't expect that in a hunk of clay, did you?

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remove harmful contaminants such as bird droppings, airborne metal particles, brake dust and tree sap. All without scratching your paint. The result is a finish that feels and looks showroom new. **Visit us at Mothers.com**



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1



2

+  
PM TEST  
DRIVEN  
+

→ Ford Taurus | Suzuki GSX-R1000 | Lexus IS 250/350 Convertible |  
**Lincoln MKT** | Mercedes-Benz E-Class Coupe | Zero S | BMW Z4 X

1 2010 Lincoln MKT

2 2010 Mercedes-Benz E-Class Coupe

## Family Thrust

While the new MKT doesn't share any exterior sheet metal with the Ford Flex, the chassis is common to both—as is the 268-hp V6. We'd plunk down extra scratch for the twin-turbo 355-hp 3.5-liter V6. Its torque curve is straight-edge flat. There is no turbo lag—none. Out on Ford's Romeo, Mich., proving grounds the turbo MKT was serene at speeds over 110 mph and satisfyingly quick. Lincoln says it should return 16 mpg city and 22 highway. That's not bad for a 4924-pound vehicle that runs so effortlessly. Inside, you'll find supportive front seats. The third row is easy to access but best left for unloved children. Of course, virtually every luxury is standard. Pricing will start five bucks short of \$50,000.

—JOHN PEARLEY HUFFMAN

## Cosmopolitan

The old CLK was just too plain to be a Benz coupe—it looked like everyone else's two-door. Well, the new E-Class coupe is undeniably unique. Under the hood of the \$48,925 E350 is a 268-hp 3.5-liter V6. The \$55,525 E550 packs a 382-hp 5.5-liter V8, and both engines are paired to a seven-speed automatic. These coupes are brimming with tech. Attention Assist monitors 70 different parameters to detect a dozing driver and then provides a wake-up warning. We are often satisfied with more frugal six-cylinder engines. But not here. After running the E350 across the lonely Nevada desert, we say get the V8. Goose the throttle and the mellow V8 burble combines with a smooth wave of torque—passing lesser machines is so easy. It's a proper luxury car. But this Benz still leans more toward refinement and pampering than its more engaging rivals. —BEN STEWART

Adaptive cruise control will automatically maintain a preset distance away from other cars and can bring the E coupe to a complete stop if needed. Similarly, Brake Assist Plus determines if a crash is imminent and can use fully autonomous braking to lessen the severity of a collision.



# WHAT WILL YOU BE THIS WEEKEND?

- |                                     |                  |
|-------------------------------------|------------------|
| <input type="checkbox"/>            | ELECTRICIAN      |
| <input type="checkbox"/>            | PLUMBER          |
| <input type="checkbox"/>            | MECHANIC         |
| <input type="checkbox"/>            | CARPENTER        |
| <input type="checkbox"/>            | HANDYMAN         |
| <input checked="" type="checkbox"/> | ALL OF THE ABOVE |

WHATEVER CHORES YOU TACKLE  
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1



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DRIVEN  
+

→ Ford Taurus | Suzuki GSX-R1000 | Lexus IS 250/350 Convertible |  
Lincoln MKT | Mercedes-Benz E-Class Coupe | **Zero S** | **BMW Z4** X

1 2010 Zero S

2 2010 BMW Z4

## Eco Rebel

Racing down NYC's West Side Highway in a downpour, the \$9950 Zero S indicates 70 mph before the acceleration tapers off. This is the first full-size, highway-legal electric motorcycle—and it's quick. Okay, 70 mph is hardly heady speed, but the 225-pound Zero is a supermoto—a dirt bike with street tires—and it excels in urban traffic. The 4-kilowatt-hour battery pack powers a 31-hp electric motor with 62.5 lb-ft of torque. Sixty seems to be the target figure; its maximum range is 60 miles and a recharge costs about 60 cents. A full charge requires around 4 hours. Seated on the tall saddle, the first impression is unprecedented lightness. With no clutch, a single gear and no noise, it's initially hard to judge how far to twist the throttle. Give it a fistful and the S will wheelie from a standstill. Breaking traffic laws never felt so clean. —WES SILER

*The Zero S is not the only road-going electric motorcycle in the company's future. Next year Zero will launch the SS—a fully faired electric sportbike based on the underpinnings of the Zero S. The sportbike should be lighter and more aerodynamic, so top speed should increase, as well as efficiency.*

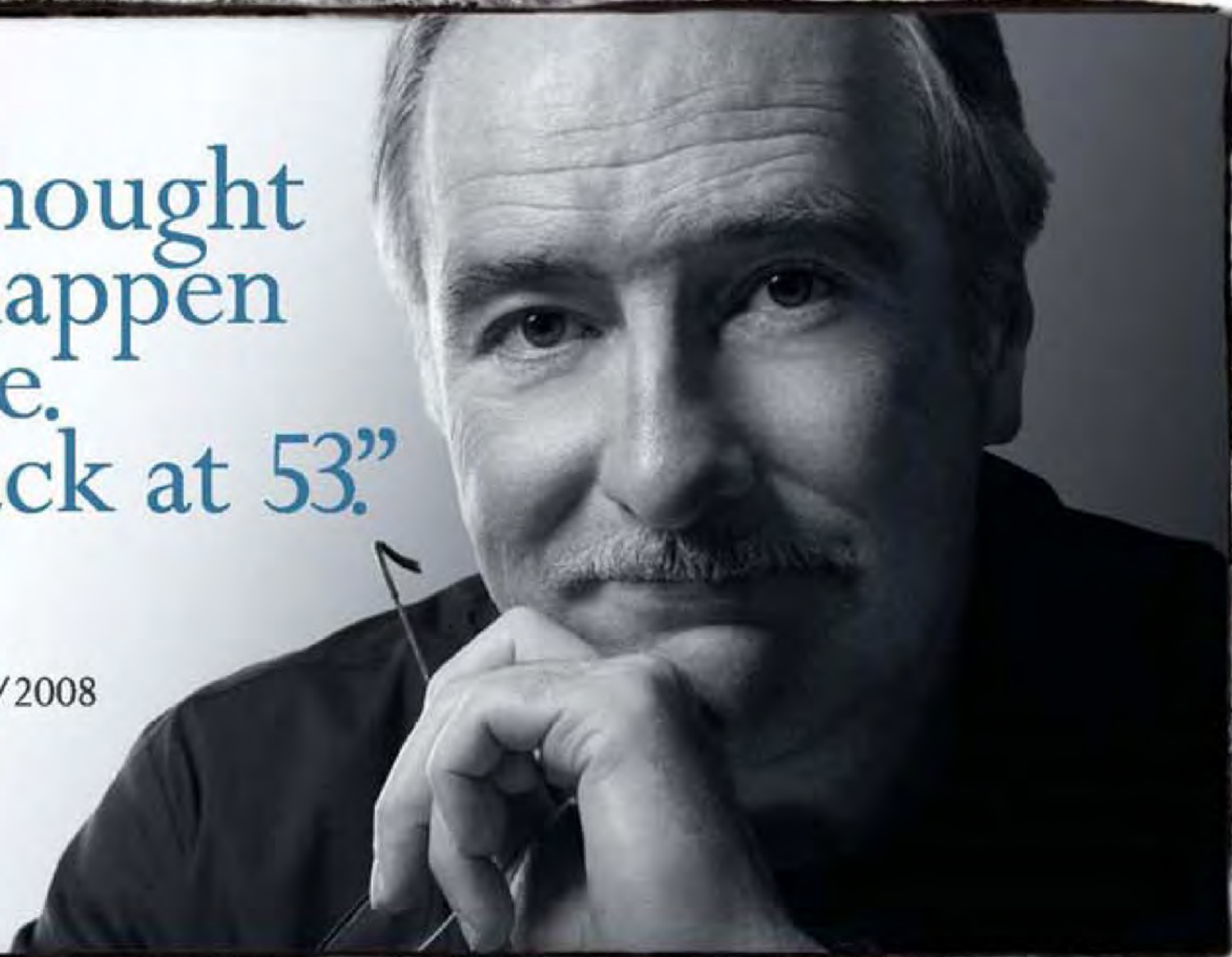
## Roads Scholar

If the last BMW Z4 had a few odd concavities, this new one is far more cohesive. And under that skin is a chassis honed on the best roads in Europe. The \$46,575 sDrive30i with 255 hp is certainly adequate, but the 300-hp twin-turbo version is seriously strong. That motor squirts the sDrive35i to 60 in 5 seconds when equipped with the fabulous seven-speed dual-clutch transmission. All Z4s have a retractable hardtop that lowers in 20 seconds. They drive superbly, with a quiver-free structure and disciplined suspension. The electromechanical steering feels naturally weighted, and the Z4 aims at corner apexes with alacrity. There's nothing like a straight Six burbling through dual tailpipes when the top is down. —BARRY WINFIELD



**"I never thought  
it could happen  
to me.  
A heart attack at 53."**

~Steve A.  
New York, NY  
Heart attack: 1/9/2008



**"I had been feeling fine. But turns out my cholesterol and other risk factors\* increased my chance of a heart attack. Now I trust my heart to Lipitor. Talk to your doctor about your risk and about Lipitor."**

- Adding Lipitor may help, when diet and exercise are not enough. Unlike some other cholesterol-lowering medications, Lipitor is FDA-approved to reduce the risk of heart attack and stroke in patients with several common risk factors, including family history, high blood pressure, low good cholesterol, age and smoking.
- Lipitor has been extensively studied with over 16 years of research. And Lipitor is backed by 400 ongoing or completed clinical studies.

\*Patient's risk factors include age, gender, smoking, and high blood pressure.

**IMPORTANT INFORMATION:** LIPITOR is a prescription drug. It is used in patients with multiple risk factors for heart disease such as family history, high blood pressure, age, low HDL ('good' cholesterol) or smoking to reduce the risk of heart attack, stroke and certain kinds of heart surgeries. When diet and exercise alone are not enough, LIPITOR is used along with a low-fat diet and exercise to lower cholesterol.

LIPITOR is not for everyone. It is not for those with liver problems. And it is not for women who are nursing, pregnant or may become pregnant. If you take LIPITOR, tell your doctor if you feel any new muscle pain or weakness. This could be a sign of rare but serious muscle side effects. Tell your doctor about all medications you

take. This may help avoid serious drug interactions. Your doctor should do blood tests to check your liver function before and during treatment and may adjust your dose. The most common side effects are gas, constipation, stomach pain and heartburn. They tend to be mild and often go away.

LIPITOR is one of many cholesterol-lowering treatment options that you and your doctor can consider.

*Please see additional important information on next page.*



**LIPITOR®**  
atorvastatin calcium  
tablets



**Have a heart to heart with your doctor about your risk. And about Lipitor.**

**Call 1-888-LIPITOR (1-888-547-4867) or visit [www.lipitor.com/steve](http://www.lipitor.com/steve)**

*You are encouraged to report negative side effects of prescription drugs to the FDA.*

*Visit [www.fda.gov/medwatch](http://www.fda.gov/medwatch) or call 1-800-FDA-1088.*



# IMPORTANT FACTS



**LIPITOR**  
atorvastatin calcium  
tablets

(LIP-ih-tore)

## LOWERING YOUR HIGH CHOLESTEROL

High cholesterol is more than just a number, it's a risk factor that should not be ignored. If your doctor said you have high cholesterol, you may be at an increased risk for heart attack. But the good news is, you can take steps to lower your cholesterol.

With the help of your doctor and a cholesterol-lowering medicine like LIPITOR, along with diet and exercise, you could be on your way to lowering your cholesterol.

Ready to start eating right and exercising more? Talk to your doctor and visit the American Heart Association at [www.americanheart.org](http://www.americanheart.org).

## WHO IS LIPITOR FOR?

### Who can take LIPITOR:

- People who cannot lower their cholesterol enough with diet and exercise
- Adults and children over 10

### Who should NOT take LIPITOR:

- Women who are pregnant, may be pregnant, or may become pregnant. LIPITOR may harm your unborn baby. If you become pregnant, stop LIPITOR and call your doctor right away.
- Women who are breast-feeding. LIPITOR can pass into your breast milk and may harm your baby.
- People with liver problems
- People allergic to anything in LIPITOR

## BEFORE YOU START LIPITOR

### Tell your doctor:

- About all medications you take, including prescriptions, over-the-counter medications, vitamins, and herbal supplements
- If you have muscle aches or weakness
- If you drink more than 2 alcoholic drinks a day
- If you have diabetes or kidney problems
- If you have a thyroid problem

## ABOUT LIPITOR

LIPITOR is a prescription medicine. Along with diet and exercise, it lowers "bad" cholesterol in your blood. It can also raise "good" cholesterol (HDL-C).

LIPITOR can lower the risk of heart attack or stroke in patients who have risk factors for heart disease such as:

- age, smoking, high blood pressure, low HDL-C, heart disease in the family, *or*
- diabetes with risk factor such as eye problems, kidney problems, smoking, or high blood pressure

## POSSIBLE SIDE EFFECTS OF LIPITOR

### Serious side effects in a small number of people:

- **Muscle problems** that can lead to kidney problems, including kidney failure. Your chance for muscle problems is higher if you take certain other medicines with LIPITOR.
- **Liver problems.** Your doctor may do blood tests to check your liver before you start LIPITOR and while you are taking it.

Symptoms of muscle or liver problems include:

- Unexplained muscle weakness or pain, especially if you have a fever or feel very tired
- Nausea, vomiting, or stomach pain
- Brown or dark-colored urine
- Feeling more tired than usual
- Your skin and the whites of your eyes turn yellow

If you have these symptoms, call your doctor right away.

### The most common side effects of LIPITOR are:

- Headache
- Constipation
- Diarrhea, gas
- Upset stomach and stomach pain
- Rash
- Muscle and joint pain

Side effects are usually mild and may go away by themselves.

Fewer than 3 people out of 100 stopped taking LIPITOR because of side effects.

## HOW TO TAKE LIPITOR

### Do:

- Take LIPITOR as prescribed by your doctor.
- Try to eat heart-healthy foods while you take LIPITOR.
- Take LIPITOR at any time of day, with or without food.
- If you miss a dose, take it as soon as you remember. But if it has been more than 12 hours since your missed dose, wait. Take the next dose at your regular time.

### Don't:

- Do not change or stop your dose before talking to your doctor.
- Do not start new medicines before talking to your doctor.
- Do not give your LIPITOR to other people. It may harm them even if your problems are the same.
- Do not break the tablet.

## NEED MORE INFORMATION?

- Ask your doctor or health care provider.
- Talk to your pharmacist.
- Go to [www.lipitor.com](http://www.lipitor.com) or call 1-888-LIPITOR.

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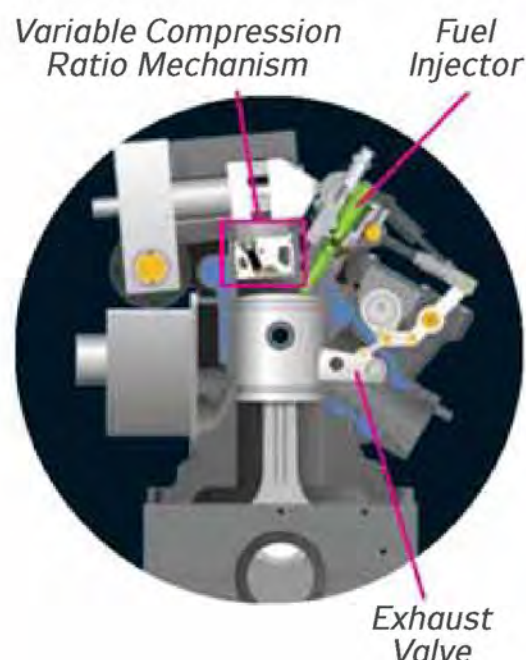
Rx only



## LOTUS OMNIVORE

### Re-Imagining the Past

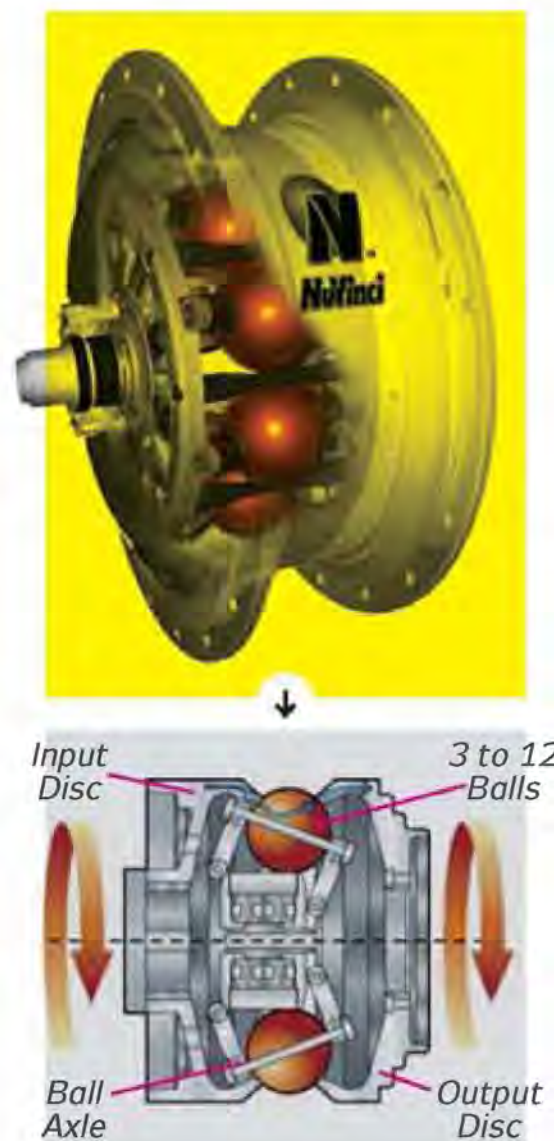
Two-stroke engines, like those found in many dirt bikes, are generally light and powerful. But in many sectors of the power-sport industry these mighty mites have been replaced by cleaner and more efficient four-stroke engines. The experimental Lotus Omnivore engine aims to deliver a better two-stroke with a host of new tech. The Lotus concept is still a piston port design, but there's direct fuel injection and a computer-controlled exhaust valve—it allows precise control of fuel delivery and exhaust recirculation—that should reduce the two-stroke's tendency to spit out unburned fuel. Most intriguing is the movable puck at the top of the combustion chamber that allows continuous compression-ratio adjustments. Lotus says this provides an opportunity for lean mixtures and homogeneous charge compression ignition. —L.W.



## NUVINCI

### Gearless Shifting

The NuVinci compact continuously variable transmission is poised to migrate from bicycles to cars. The working principle is similar to a planetary gearset, but here, the power flows across a ring of planet balls. Tilting the axis of these balls seamlessly changes the ratio between the input and output cases. While it can be scaled up for automotive applications to transfer engine torque and doesn't require power-robbing high-pressure oil like conventional CVTs, we'll likely first see it running downsized accessories such as alternators. The system could also alter the speed and boost of a supercharger, which would allow an engine to take advantage of high-octane, alcohol-based fuels. —L.W.



## FOAMLESS SEATS

### Lightweight Thrones

A car's front bucket seats can weigh more than 50 pounds each—especially if they are loaded with luxury features like heating, cooling and, yes, even massage capability, as in the Mercedes S-Class. And this excess avoirdupois presents a juicy target for weight savings. French auto parts manufacturer Faurecia has developed the Sustainable Comfort Seat, 17 percent lighter than conventional seats. It doesn't use foam. Instead, a pair of dimpled, injection-molded plastic forms cover a nylon and fiberglass frame. It's also over an inch thinner than most conventional seats, leaving more room for rear passengers. —L.W.



### Ultimate Run-Flat

Four years after its public unveiling, development continues on Michelin's airless tire, the Tweel. During a recent conversation with one of the inventors, Bart Thompson, we learned that the Tweel will first be available for skid steers, ATVs and low-speed Third World cars like the Tata Nano in as little as 24 months. According to Thompson, "It's the bottom-of-the-market-type applications, where historically disruptive technologies have transformed industries." The polyurethane-spoke design remains, but the company is working to reduce high-speed vibration that so far has made it unsuitable for U.S. cars. —L.W.



## Long-Term Test Cars

THE SPORTY MAXIMA LEAVES OUR FLEET AND MAKES ROOM FOR A RUGGED DODGE RAM 4x4.

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PM TEST  
DRIVEN  
+



### Dodge Ram 1500 Laramie Crew 4x4

+

FIRST report

These are certainly tough times for Chrysler, but you'd never know that sitting in these luxurious power-ventilated leather seats or wrapping your hands around the heated leather steering wheel. The new Ram is the best pickup truck Dodge has ever

built—and it's packed with innovation. The rear axle is now suspended with coil springs for a smoother ride. The 390-hp 5.7-liter Hemi V8 has variable valve timing and multiple-displacement technology that lets it cut half the cylinders when traveling

at constant speeds to boost fuel economy. The optional RamBox bed provides lockable storage on the bed-sides, and there are two handy floor bins in the cab that can hold ice-cold drinks for the whole crew. Earlier this year we tested the Ram against its

■ **VITAL STATISTICS** Base price \$43,490 : As-tested price \$52,520 : Extra-cost options Leather seats, 3.92:1 axle ratio, power sunroof, 32-gallon fuel tank, uconnect GPS, RamBox cargo management, class IV hitch : Drivetrain 5.7-liter V8, 5A, 4WD : Engine performance 390 hp, 407 lb-ft of torque : EPA fuel economy 13 city/18 hwy



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PM LONG-TERM  
TEST CARS

competition (Jan. '09) and found it was a near split decision with the F-150. A test result that close deserves further investigation. So we recently took delivery of a Deep Water Blue Pearl 2009 Dodge Ram equipped similarly to the truck in that test. Our 1500 Laramie is fully loaded. And that means it has the aforementioned RamBox, Hemi and an interior that rivals a luxury sedan's. We'll put this Ram through the wringer on city streets and use it for towing chores and numerous trips to home-improvement stores on the weekends. We might even find a 4WD trail or two to test the truck's off-road capability. We can't wait to put this Dodge to work. — BEN STEWART



Crew-cab Rams have two handy floor bins. Each one of these secretive storage lockers can swallow 10 soda cans each, with ice.



VW Jetta TDI Loyal Edition



SECOND report

One look at the odometer and you know we're digging our diesel. The Jetta has logged just over 7000 miles so far, and they haven't been easy miles. Yes, we've tried to maximize our fuel economy on a few trips. But L.A.'s stop-and-go traffic, combined with a few blasts to far-flung Southwest towns at, ahem, supra-legal speeds, means our fuel economy has yo-yoed from the mid-20s to the high 30s. On one of those trips, we may have filled up with a rotten tank of fuel, too—a station outside El Centro comes to mind. When we returned late that night, a fairly innocuous Check Engine light lit up. The next morning our engine went into limp-home mode, and we drove right to Santa Monica VW. The dealer techs found that the fuel system had been contaminated with either water or bad diesel. So the entire fuel system was replaced, along with the fuel tank itself—all under warranty. Since then, the TDI has been just as bulletproof as it was before. It has incredible range: Our best tank lasted nearly 500 miles. And from now on, we only stop where we know there's quality fuel. — B.S.

DRIVERS NOTEBOOK

- Torque-rich TDI motor gets the jump on some much sportier cars.
- The soft suspension means it's no sports sedan in the canyons, but the Jetta eats potholes like a luxury sedan.

- Our VW drives small, yet the commodious 16-cubic-foot trunk rivals a full-size sedan's.

DATA SO FAR

As tested : \$24,190  
Previous reports :  
See 05/09

Miles driven : 7120

Miles since last report : 2861

Fuel economy :

Average—32 mpg

Worst—26.7 mpg

Best—37.2 mpg

Maintenance/repair : \$0

Subaru Forester 2.5XT Limited



THIRD report



For a long time, the Forester was easy to overlook in the Subaru lineup. It wasn't cute and sporty like the WRX, but neither did it exude that "my other house is a ski chalet in Vermont" vibe like the Outback. It was just a tall, boxy station wagon—one that effectively disguised a pretty impressive drivetrain under the skin. Subaru gave the Forester a full redesign for 2009, and after six months in our fleet, this spunky crossover has earned everyone's respect. The appreciation starts with the turbocharged, horizontally opposed four-cylinder engine





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PM LONG-TERM  
TEST CARS

(the same one Subaru uses in the high-performance WRX). So the Forester is more fun to drive than a crossover has any right to be. But, yes, Mom, it's practical too. We've hauled lots of kids and supplies without ever running out of room. And the AWD system proved its mettle on some steep, muddy roads in Maine. You can see this vehicle's split personality in our mileage numbers: from a low of 12 mpg (someone was *working* that turbo) to a high of 35 (proving PM editors can hypermile too).

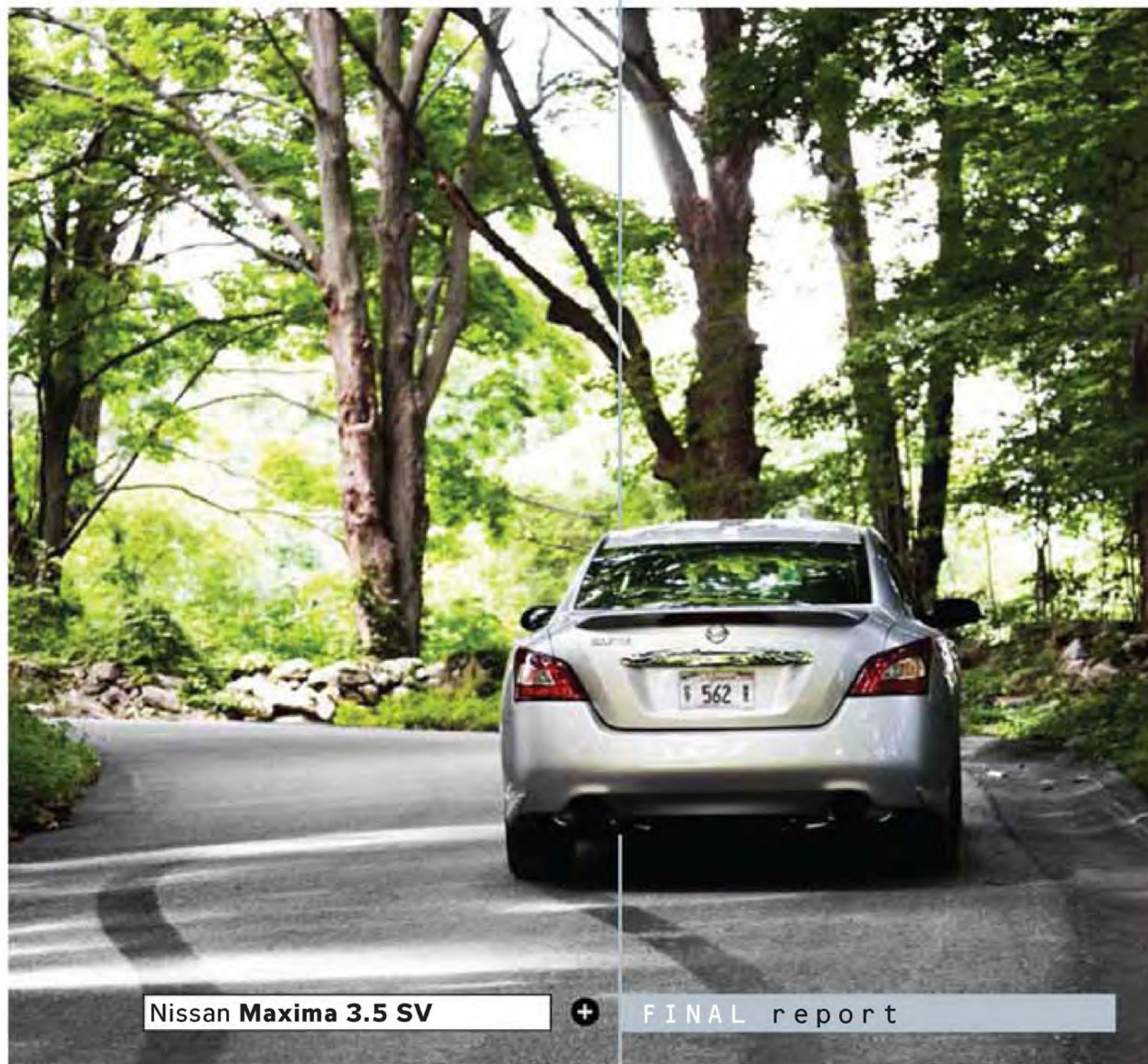
— JIM MEIGS

DRIVERS NOTEBOOK

- The blue undercarriage lights that come on when you unlock the vehicle? Cool.
- The bright white night-vision-blasting nav screen that flashes on every time you start the car? Not cool.

DATA SO FAR

As tested : \$32,420  
Previous reports :  
See 02/09, 05/09  
Miles driven : 9127  
Miles since last report : 3284  
Fuel economy :  
Average—20.6 mpg  
Worst—12.2 mpg  
Best—35.1 mpg  
Maintenance/repair : \$55.98



Nissan Maxima 3.5 SV



FINAL report

Our Maxima's fuel economy has improved steadily as the engine breaks in—finally delivering an average over 20 mpg in a combination of urban traffic jousting and road trips. A few days before the scheduled 7500-mile service, a warning light announced that the battery in the key fob needed replacing. The battery was replaced by the dealer for the princely sum of \$35.75, because that's not covered under the warranty. We have to wonder if that's going to be an annual occurrence. Next time, we'll source the battery at RadioShack and save the \$23 installation fee. Soon after, we picked up a tiny stone chip in the corner of the driver's side of the windshield, courtesy of a dump truck's tire hitting a pothole. Thanks, pal. Normally, we would just use a windshield repair kit to plug the imperfection to prevent cracking. But before we returned home, the crack had grown, and within a few days, had migrated to the middle of the windshield. Our local dealer replaced the glass on one day's notice, and returned the car in only four hours. The Maxima was a solid, reliable sports sedan, but our local Nissan dealer deserves some credit too. Great service. We'll miss our Max. — MIKE ALLEN



DRIVERS NOTEBOOK

- We're addicted to the rearview camera. Parking in tight spots is almost too easy.
- The paddle shifters are great fun, even if the firm shifts annoy our passengers.
- The throttle response just off idle is a little aggressive.

END DATA

As tested : \$37,550  
Previous reports :  
See 11/08, 02/09, 05/09  
Miles driven : 9682  
Miles since last report : 2670  
Fuel economy :  
Average—20.9 mpg  
Worst—19.3 mpg  
Best—24 mpg  
Maintenance/repair since last report : \$695  
Overall: \$741.14





**Availability Limited to  
only 2500 Orders!**

## How's This For a Stimulus Package? FREE Ruby Pendant for the First 2500 Responders

*Our gift to you: A one carat radiant, lab-created ruby pendant*

Here's some important news that will affect your bank account. But it's good news, for a change. You see, while Congress was busy cutting billion dollar checks to the banks and big corporations, we concocted our own bailout plan. And ours won't cost the taxpayer a dime and looks a million times better with a cocktail dress.

In tough economic times, it's just not good enough to offer meager discounts of 10% and 20%. Even "half-off" has become ho-hum. That's why we're going all the way. Our stunning *Scienza™* lab-created *Ruby Pendant* can be yours for **FREE** (You pay nothing except basic shipping and processing costs). Similar designs can be found at the largest jewelry stores in America for \$299. But for a limited time, **you can take 100% off!**

This is no joke. There is no catch. Simply call our toll-free number or log on to [www.stauer.com](http://www.stauer.com). The first 2500 to respond to this ad will get the *Scienza™* lab-created *Ruby Pendant* absolutely **FREE**. If you're wondering exactly how we can afford to do this... read on.

**Why give away jewelry?** Our real goal is to build a long term relationship with you. We are convinced you will become a loyal Stauer client in the years to come. But for now, in this lousy economy, offering this remarkable pendant seemed the best way for you to give us a try.

The *Scienza™ Ruby Pendant* features an impressive 1-carat oval-cut, lab-created ruby prong-set in luxurious gold vermeil. Surrounding the radiant red oval are 14 brilliant-cut, lab-created *DiamondAura®* dazlers. The combination sparkles with a passionate fire that is even brighter than most mined stones.

**The world's most valuable gemstone.** For thousands of years, the luxury of natural rubies has been coveted by pharaohs, emperors and royalty from all continents. Known as the "king of all precious stones," the red glow of a ruby symbolizes love, life and desire. But such beauty can come at a steep price and even today, rubies remain some of the most expensive gems on Earth.

**Can science really improve nature?** The right chemistry is vital in any romantic relationship. We had to get it perfect. That's why the gemologists worked for years to create the world's most romantic, most colorful lab-created ruby. Our *Scienza™* are scientifically grown, crafted in laboratories with precise equipment that recreates the high pressures and heat that nature uses to produce gemstones far beneath the surface of the earth. *Scienza™* are chemically identical to the natural gemstone in hardness and display a better color and sparkle than most mined corundum.

But mined rubies can cost up to \$5,000 per carat for this level of color and clarity! The *Scienza™* originates from an ingenious process that lets you experience the seductive fire of priceless gems without the exorbitant cost. You pay nothing except basic shipping and processing costs of \$25.<sup>95</sup>, the normal shipping fee for a \$200-\$300 pendant

**It's okay to be skeptical.** But the truth is that Stauer doesn't make money by selling one piece of jewelry to you on a single occasion. Our success comes from serving our long term clients. Be one of the first 2500 to respond to this ad and receive 100% off while getting a closer look at Stauer's exclusive selection of fine jewelry.

#### JEWELRY SPECS:

- 1 carat 5mm x 7mm lab-created, oval-faceted ruby
- 1/5 ctw white *DiamondAura* - Gold vermeil setting

**Scienza™ Lab-created Ruby Pendant** (1 1/5 ctw) **Your Cost—FREE**  
— pay shipping & processing only.

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## FLYING A LEGEND

> BY JEFF WISE

> ILLUSTRATION BY PATRICK LEGER



OUR INTREPID REPORTER FULFILLS A BOYHOOD DREAM: FLYING A WORLD WAR II P-51 MUSTANG.

Y

**ou never forget** your first 60 seconds airborne in a P-51 Mustang.

I'm strapped into the back seat of *Crazy Horse 2*, a vintage World War II fighter plane that pilot Lee Lauderback is lining up at the end of a runway in Kissimmee, Fla. I've got a parachute around my torso and a harness securing me to the airframe. Just in case, I've been briefed on how to pop the top of the canopy and bail out.

Lauderback opens the throttle on the huge 1490-hp Rolls-Royce-built Merlin engine. The 12 cylinders rise to a throaty roar, and we start to move. As we gain speed, the tail lifts, and we float off the runway. We hold steady, flying 25 feet above the ground until the airspeed indicator passes 150 mph. Then Lauderback pulls sharply on the stick; the nose swings up into the sky, and we rocket to 1000 feet.

Leveling off, we barrel along beneath the clouds at 200 mph, the sun-dappled Florida flatlands sweeping past below us. "Okay," Lauderback says, "your controls." He lifts both hands above his shoulders, open-palmed.

I grasp the control stick and nudge it to the

right—enough to feel the wing dip—then bring the plane back to level. Even though I've been a pilot for seven years, I've never felt a tingle in my spine like this. I'm flying a P-51.

Not many boyhood fantasies retain their appeal into adulthood, and fewer still are ever realized. But I'm flying with a man who specializes in wish fulfillment. Lauderback's company, Stallion 51, provides a rare flight experience for those, like me, who've fallen under the spell of World War II warbirds. Anyone can strap in, and Lauderback gives you control of the aircraft and talks you through air-combat maneuvers. The experience is unexpectedly intense. "Everyone who comes here bonds to the aircraft," Lauderback says.



The P-51 Mustang's story began in 1940, when Britain desperately needed more planes to combat Nazi Germany's Luftwaffe. Designers at North American Aviation (later absorbed into Boeing) promised a plane that could outperform anything in the air. Four months after the company signed the contract, a prototype was ready to fly. Sporting revolutionary engineering and a menacing, sharklike profile, it had a top speed of 437 mph and a ceiling of almost 42,000 feet. The United States Army Air Forces made it the key to its long-range fighter force; by war's end, Mustang pilots had destroyed nearly 5000 German airplanes. The P-51 became the embodiment of American air supremacy. "It's a national treasure," Lauderback says.

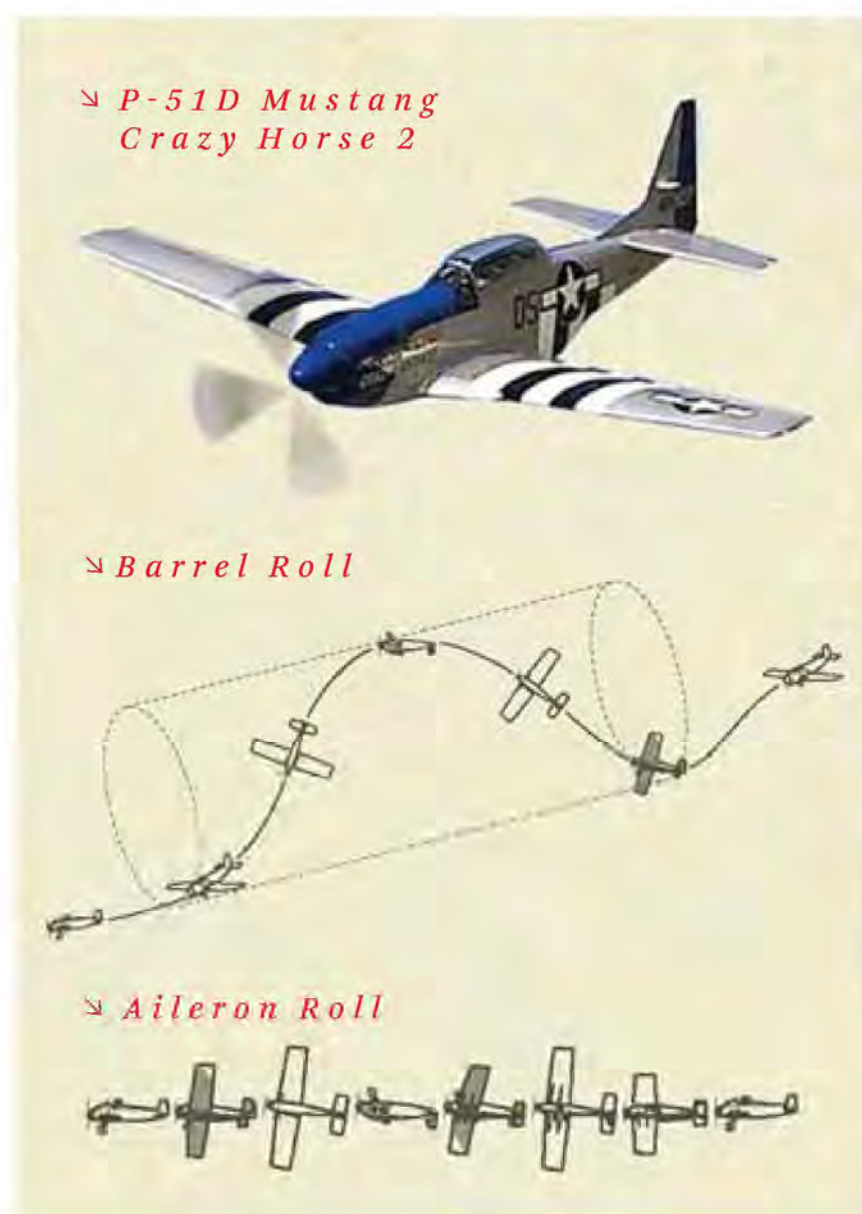
*Crazy Horse 2* started as a single-seat P-51D, but after the war a back seat was added so the plane could be used as a trainer. There are only 16 like it in the world, and just 165 Mustangs of any stripe—1 percent of the 16,000 produced during the war.

Mustangs weren't designed to last very long—their life expectancy in combat was only 200 hours. To stay in the air, *Crazy Horse 2* has undergone substantial restoration, with only about half the original airframe remaining. The result is a 64-year-old, \$2.7 million aircraft that's functionally new. But the plane still feels like it's straight out of the '40s, with solid-looking metal levers and handles and round steam-gauge-style dials to indicate altitude, airspeed and other essential data.

With Lauderback coaching, I add power and climb through the clouds. Soon we're floating along at 7000 feet. I spend a few minutes getting comfortable with the plane, climbing, diving and making turns. Compared to modern sport planes, the



Pilot Lee Lauderback briefs PM contributing editor Jeff Wise before a flight above central Florida in a P-51D Mustang, a celebrated World War II fighter plane. Lauderback talked Wise through barrel rolls, aileron rolls and other aerobatics.



Mustang is stable and slow-rolling: It's a Cadillac, not a Carrera.

Lauderback shows me some basic maneuvers; then it's time to try a few aerobatics. He tells me to put the nose down into a dive, and we pick up speed until the gauge reads 300 mph. I pull back on the stick. The g-forces build as the nose rears higher, higher, higher. The canopy in front of me fills with blue. "That's vertical," he says. "Give me a little bit of right rudder ... a little bit more ... just a touch more elevator." Now the horizon appears again, sky and clouds and earth, all the wrong way around—but I don't feel upside down. The centrifugal force has me pinned to my seat.

The horizon slides beneath us; now we're facing the earth. Our dive bellies, and the g's start to push me down with real weight. As we come through level, the plane shudders. "You've hit your own prop wash," Lauderback says. We've come back to the spot where we started the loop: "Couldn't have done it better."

Lauderback talks me through a half-dozen more maneuvers; whether I'm right side up or upside down, the Mustang powers through like it's on rails. Too soon, our hour is up. The cumulus clouds have been building into thunderstorms, and the Kissimmee tower tells us to expedite our trip home if we want to land before the next shower hits.

I stay on the controls all the way back. Crosswinds blast us at 30 mph, but the Mustang remains on course, as solid as a locomotive. After we taxi to the hangar, the canopy slides open and we climb out. When I see my reflection in the plane's mirrored skin, I realize I'm hooked. I need \$2.7 million, quick. **PM**



BY BRAD REAGAN

# REASONABLE DOUBT

THE SURPRISINGLY  
WEAK SCIENCE  
BEHIND  
COURTROOM  
FORENSICS.

PHOTOGRAPHS BY  
CHRISTOPHER GRIFFITH  
STYLING BY  
MEGAN CAPONETTO



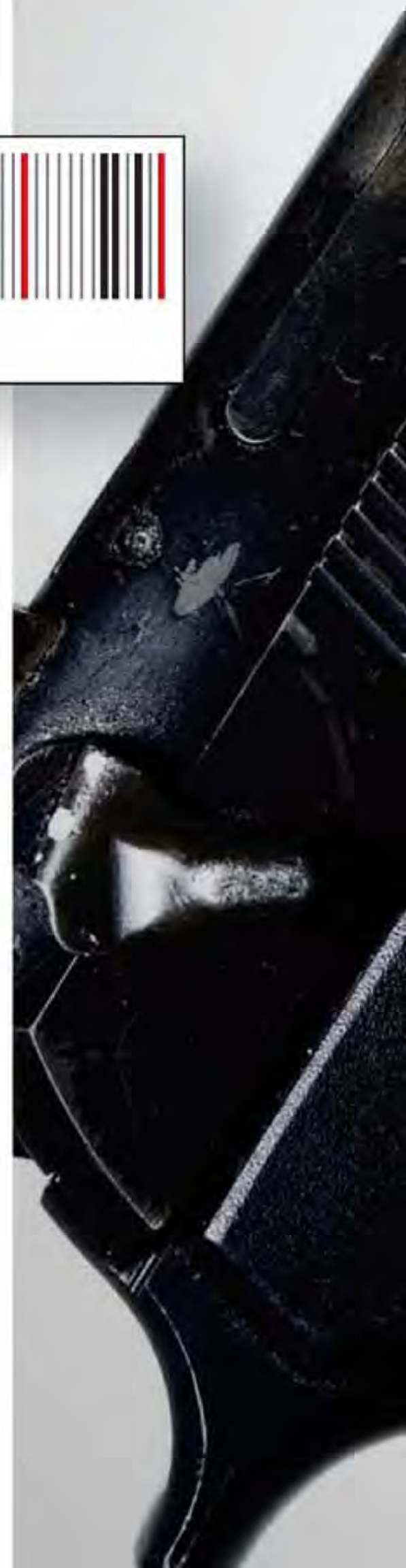
## ON JAN. 11, 1992, THE JURY IN THE MURDER TRIAL OF ROY

Brown heard from a dentist named Edward Mofson. To establish his credentials, Dr. Mofson testified that he was certified in forensic odontology, belonged to six related professional organizations and did forensic consulting throughout New York state. He then explained that several months earlier he was called to the morgue in Cayuga County, New York, to analyze the body of 49-year-old Sabina Kulakowski.

Kulakowski's corpse was found by a volunteer firefighter on a dirt road some 300 yards from the farmhouse where she lived, which had burned to the ground in the night. She was severely beaten and stabbed,

46

AUGUST 2009 | POPULARMECHANICS.COM







## Fingerprints

*Fingerprints were long regarded as the highest standard of forensic evidence, but experts now question exactly what constitutes a match.*

»

### The Technique

Fingerprint investigations strive to match a print left at a crime scene to a print on file or in a database. The accepted technique for scrutiny is called ACE-V, for analysis, comparison, evaluation and verification. Examiners study features such as ridge shapes, patterns and lengths, looking for agreement—some jurisdictions look for a certain number of “points” of similarity to constitute a match. The final step, verification, occurs when a second examiner reaches the same conclusion. Many law enforcement agencies use computerized fingerprint identification systems to identify potential matches, but human examiners always have the final say.

**Fingerprint evidence is captured from surfaces using powders, lasers, even Super Glue.**

### The Debate

No studies have proved definitively that fingerprints are unique. Likewise, it is unclear if prints change over time or vary depending on the amount of pressure applied. Statistical models and pattern-recognition software could go a long way toward answering these questions. Additionally, research is needed to expose error rates. The ACE-V method depends on two or more examiners reaching the same subjective conclusion, but doesn't require them to reach it the same way. In one recent experiment, veteran examiners looking twice at the same print came to different conclusions each time.



and there were multiple bite marks on her body. Brown was a natural suspect in the grisly murder. The week before the crime, the hard-drinking 31-year-old had been released from jail on charges of threatening to “wipe everybody out” at the social services office where Kulakowski worked; the agency had put his daughter into foster care. In addition to the motive, the district attorney at trial produced other circumstantial evidence, including testimony from Brown’s two ex-wives that he had bitten them. But Mofson, now deceased, was the centerpiece of the prosecution.

Mofson testified that seven bite marks found on Kulakowski were “entirely consistent” with dental impressions taken from Brown. It was the only physical evidence tying Brown to the crime. Although a defense expert disputed Mofson’s findings, the jury convicted Brown of second-degree murder. He was sentenced to 25 years to life in prison.

As the years ticked by, few listened as Brown proclaimed his innocence from his cell in the Elmira Correctional Facility. Then Brown got an unusual lucky break. His stepfather’s house burned down, taking with it all of his records from the trial. To replace his documents, Brown submitted an open records request to the county. The sheriff who processed Brown’s request mistakenly sent him the entire investigative file. It revealed another suspect: Barry Bench, the firefighter who discovered Kulakowski’s body. Bench’s brother had dated Kulakowski up until two months before the murder and Bench was reportedly upset that she continued to live in the family farmhouse. On the day before Christmas in 2003, Brown sent a letter to Bench letting him know he was seeking DNA testing. “Juries can make mistakes,” he wrote. But, “DNA is God’s creation, and God makes no mistakes.” Soon after receiving the message, Bench committed suicide by jumping in front of an Amtrak train. DNA tests confirmed that Bench was guilty of Kulakowski’s murder, and Brown was set free.

**THE FAULTY IDENTIFICATION THAT SENT BROWN** to prison for 15 years may seem like a rare glitch in the U.S. criminal justice system. It wasn’t. As DNA testing has made it possible to re-examine biological evidence

from past trials, more than 200 people have had their convictions overturned. In approximately 50 percent of those cases, bad forensic analysis contributed to their imprisonment.

On television and in the movies, forensic examiners unravel difficult cases with a combination of scientific acumen, cutting-edge technology and dogged persistence. The gee-whiz wonder of it all has spawned its own media-age legal phenomenon known as the “CSI effect.” Jurors routinely afford confident scientific experts an almost mythic infallibility because they evoke the bold characters from crime dramas. The real world of forensic science, however, is far different.

America’s forensic labs are overburdened, understaffed and under intense pressure from prosecutors to produce results. According to a 2005 study by the Department of Justice, the average lab has a backlog of 401 requests for services. Plus, several state and city forensic departments have been racked by scandals involving mishandled evidence and outright fraud.

But criminal forensics has a deeper problem of basic validity. Bite marks, blood-splatter patterns, ballistics, and hair, fiber and handwriting analysis sound compelling in the courtroom, but much of the “science” behind forensic science rests on surprisingly shaky foundations. Many well-established forms of evidence are the product of highly sub-

jective analysis by people with minimal credentials—according to the American Society of Crime Laboratory Directors, no advanced degree is required for a career in forensics. And even the most experienced and respected professionals can come to inaccurate conclusions, because the body of research behind the majority of the forensic sciences is incomplete, and the established methodologies are often inexact. “There is no scientific foundation for it,” says Arizona State University law professor Michael Saks. “As you begin to unpack it you find it’s a lot of loosey-goosey stuff.”

Not surprisingly, a movement to reform the way forensics is done in the U.S. is gaining momentum. The call for change has been fueled by some embarrassing failures, even at the highest levels of law enforcement.

Because of misleading forensic evidence, Roy Brown spent nearly a third of his life in jail for a murder he didn’t commit.





## Ballistics

*Forensic examiners use the marks left on bullets to match them to specific firearms, but the technique lacks a solid base of research, and errors are common.*

»

### The Technique

The theory behind ballistics analysis is that the manufacture and use of a firearm produces unique tool marks inside the barrel, which are then transferred to each bullet fired from that gun. Forensic examiners measure bullet size to determine caliber, then check the direction of rifling marks and the degree of twist to narrow down the gun's manufacturer. To match a specific firearm to a bullet, investigators test-fire the weapon with a new slug and compare both bullets under a microscope, looking for identical striations. Investigators can also query computer databases that suggest potential matches.

**New 3D imaging technology can analyze bullet markings for both surface pattern and depth.**

### The Debate

As with fingerprints, not enough research has been done to quantify the probability of error in ballistics matching. So it's impossible to say with certainty that the marks made on bullets as they are fired are truly unique to an individual gun. Currently, ballistics

examiners are aided by computer databases such as the ATF's National Integrated Ballistic Information Network, but lab techs always rely on their own visual inspection to make the final call. The Association of Firearm and Tool Mark Examiners only requires an examiner to find "sufficient

agreement" between bullets in order to conclude that they came from the same gun. Those judgment calls can cause false results. Last September the Detroit Police Department's crime lab was shut down after an audit by the state of Michigan found a 10 percent error rate in ballistics identification.



After the 2004 train bombings in Madrid, Spain, the FBI arrested Oregon lawyer Brandon Mayfield and kept him in jail for two weeks. His incarceration was based on a purported fingerprint match to a print found on a bag of detonators discovered near the scene of the crime. As a later investigation by the Justice Department revealed, the FBI's fingerprint-analysis software never actually matched Mayfield to the suspect fingerprint, but produced him as an "unusually close nonmatch." Lacking any statistical context for how rare such similarities are, investigators quickly convinced themselves that Mayfield was the prime suspect.

The next year, 2005, Congress commissioned the National Academy of Sciences (NAS) to examine the state of forensics in U.S. law enforcement. The result was a blistering report that came out this February, noting "serious deficiencies" in the nation's forensic science system and advocating extensive reforms. It specifically noted that apart from DNA, there is not a single

forensic discipline that has been proven "with a high degree of certainty" to be able to match a piece of evidence to a suspect. The obvious implication is the sobering possibility that more Roy Browns are currently locked up based on shoddy science. Then there's the flip side: A lot of bad guys who should be in prison still roam free. A study by the Innocence Project of the prisoners exonerated by DNA found that the real perpetrators were identified in 103 cases—roughly half. In all but one, the perpetrator committed at least one serious crime after the innocent person was jailed.

### THE SCIENTIFIC METHOD IS INSTRUMENTAL TO

our understanding of the physical world. To scientists, the process is sacrosanct: Research your topic, generate a hypothesis, test the hypothesis, analyze your data and then publish the results for peer review. Forensic science, however, was not developed by scientists. It was created by cops—often guided by little more than



## Trace Evidence

*Analysis of paint, fibers and soil found at crime scenes has the potential to be good science, but more substantiating research is needed.*

»

### The Technique

Trace evidence found at crime scenes can include everything from paint residue to clothing fibers to deposits of soil. These samples are then subject to pattern-matching and microscopic and chemical analysis. In the case of paint, it's critical for the evidence-collection team to return a sample that includes all possible layers—this makes it easier to match a sample to the object it came from. If multiple paint chips are found from the same source, it is sometimes possible to piece the chips together by matching brush-stroke striations or abrasions. When comparing fibers that appear to be similar, examiners perform a series of analytical chemistry tests to determine composition (natural or man-made, for example), color variations, shape and solubility.

**The FBI's National Automotive Paint File has more than 40,000 entries dating back to the 1930s.**

### The Debate

Paint analysis has a relatively strong scientific backing, and it can provide reliable results. Studies have shown that more than 97 percent of random auto paint samples and 99 percent of

architectural paint samples can be differentiated. That can be useful for establishing that two samples might have a common origin (say, a particular brand of car paint), but current techniques aren't sophisticated enough to rule out all other sources. Likewise, fiber analysis has a foundation in chemistry; however, more research is needed to determine the criteria for a match. Current methodology is only sufficient to conclude that fibers could have come from the same type of garment or carpet.





common sense—looking for reliable ways to match patterns from clues with evidence tied to suspects. What research has been done understandably focuses on finding new techniques for putting criminals in jail.

In the academic community the legal sciences get a comparative trickle of federal funding. In 2007, the National Institute of Justice awarded 21 grants for forensic research (excluding DNA) totaling \$6.6 million; the National Institutes of Health awarded 37,275 grants totaling \$15 billion. And without a wealth of statistically defensible research to back up their evidence, forensic examiners generally rely upon their own intuition and the experience of their colleagues. “You can’t take a few case studies and say, ‘Oh, it worked on these people; it must be reliable,’” says Karen Kafadar, an Indiana University statistics professor and a member of the NAS committee. “That is hardly a placebo-controlled, double-blind randomized trial.”

The FBI’s errors in the Madrid bombing case were particularly surprising because they called into question one of the gold standards of evidence—fingerprints. In recent years, legal experts have become deeply concerned about the accuracy of the “friction ridge analysis” central to fingerprint identification. Fingerprints are believed to be unique, but the process of matching prints has no statistically valid model. And forensic examiners are often working in an imperfect world, where prints taken in a police station on an ink pad are compared to prints left at a crime scene, which may be smudged or partially captured. Yet, as University of California–Los Angeles law professor Jennifer Mnookin has written, “fingerprint examiners typically testify in the language of absolute certainty.”

A 2006 study by the University of Southampton in England asked six veteran fingerprint examiners to study prints taken from actual criminal cases. The experts were not told that they had previously examined the same prints. The researchers’ goal was to determine if contextual information—for example, some prints included a notation that the suspect had already confessed—would affect the results. But the experiment revealed a far more serious problem: The analyses of fingerprint examiners were often inconsistent regardless of context. Only two of the six experts reached the same conclusions on second examination as they had on the first.

Ballistics has similar flaws. A subsection of tool-mark analysis,

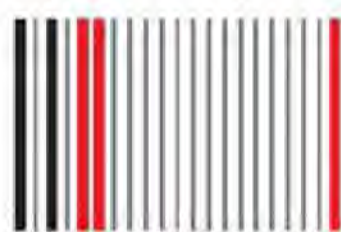
ballistics matching is predicated on the theory that when a bullet is fired, unique marks are left on the slug by the barrel of the gun. Consequently, two bullets fired from the same gun should bear the identical marks. Yet there are no accepted standards for what constitutes a match between bullets. Juries are left to trust expert witnesses. “I know it when I see it” is often an acceptable response,” says Adina Schwartz, a law professor and ballistics expert with the John Jay College of Criminal Justice.

#### NOT ALL FORENSIC DISCIPLINES ARE IN DISPUTE.

Techniques that grew out of organic chemistry and microbiology have a strong scientific foundation. For example, chromatography, a method for separating complex mixtures, enables examiners to identify chemical substances in bodily fluids—evidence vital to many drug cases. The evolution of DNA analysis, in particular, has set a new scientific standard for forensic evidence. But it also demonstrates that good science takes time.

The double-helix structure of DNA was discovered in the 1950s, but it wasn’t until 30 years later that sample analysis became sophisticated enough for positive ID. In 1987, a serial rapist by the name of Tommie Lee Andrews was the first person convicted in the U.S. using DNA. Nevertheless, for several years scientists continued to research and debate what constitutes a satisfactory match. The resulting process is broadly accepted and quantifiable (when using the most advanced analysis, there is a one in more than a quadrillion chance of a random match of two strangers’ nuclear DNA).

But DNA constitutes less than 10 percent of the case load at U.S. crime labs. The goal going forward, everyone agrees, is to make the rest of forensics more rigorous and statistically grounded. Promising work is already being done: Sargur Srihari, a pattern-recognition expert



**FORENSIC SCIENCE  
WAS NOT DEVELOPED  
BY SCIENTISTS. IT WAS  
CREATED BY COPS—OFTEN GUIDED BY  
LITTLE MORE THAN COMMON SENSE.**



## Biological Evidence

*The research and rigor behind DNA science has turned biological evidence into the strongest tool in the courtroom.*

»

### The Technique

A critical challenge in utilizing biological evidence is first finding it, and then figuring out exactly what it is. Blood at a crime scene may not always be visible (if, for instance,

someone has attempted a cleanup), so investigators apply chemicals, such as luminol, that change color as red blood cells release oxygen. Immunological tests can be performed in the lab to identify proteins, such as hemoglobin, that

can indicate if the blood is human. Hair samples are examined microscopically for characteristics such as color, chemical treatment, shaft form (wavy, straight, curly) and pigment distribution. All biological samples have the

potential to yield useful DNA evidence. When labs perform nuclear DNA testing, examiners look for matches on up to 16 short tandem repeat (STR) loci, which vary considerably from person to person. Where nuclear DNA is

either degraded or not available—for instance, bones, teeth and hair samples that have no roots—the less-exacting mitochondrial DNA (mtDNA) testing process is typically employed.

### The Debate

Before DNA testing, blood and hair were considered “class evidence.” That means serological typing of blood samples and microscopic analysis of hair could only narrow down a list of possible suspects. Research has shown that matching hairs using subjective analysis can be highly inaccurate (one FBI study found a 12.5 percent error rate). By comparison, the statistical probability of a false positive using the most advanced DNA testing kits can be as low as one in more than a quadrillion.



**DNA must be extracted from white blood cells. Red cells lack nuclei.**





**DNA can be found in hair years after a crime has been committed.**

with the State University of New York at Buffalo, is developing software to help quantify the certainty of fingerprint matches. And, Nicholas Petraco, a chemist and mathematician at John Jay, is working on a database of microscopic tool marks to give statistical significance to the identification of burglars' tools.

The NAS report recommends the establishment of an independent entity—a National Institute of Forensic Science—which would be the central authority responsible for funding research as well as creating and promulgating the standards of evidence and certification for experts. If such a system worked properly, juries would only hear from experts who are certified in their fields and examiners who work in accredited laboratories.

It's likely that the microscope of serious scientific scrutiny will turn disciplines such as fingerprint and ballistics analysis, which have long histories and large sample sizes, into stronger standards of evidence. But many other forensic disciplines may be classified as far less sound. Bite marks, footprints, tire tracks, handwriting, bloodstain patterns and other forms of analysis that suffer from multiple confounding variables could end up being used as exclusionary evidence or as qualified supporting evidence only. Some types of evidence may be completely discredited. That's what happened with voiceprint analysis and lead analysis of bullets, which were popular forensic techniques until studies showed significant error rates.

Within the forensic community, the reaction to the

mounting criticism is mixed. Some are offended and blame the “propaganda” of defense attorneys and the snobbery of academics. Dean Gialamas, president of the American Society of Crime Laboratory Directors, says most techniques have “a strong foundation in science” even if they have not been subject to the type of applied research needed to satisfy critics. And he notes that his organization has long advocated more standardization and stronger ethics rules, so hired guns can't pollute courtrooms with biased testimony. At the end of the day, Gialamas and most other forensic experts say they are confident their methods will ultimately be validated by further research. Even critics of the current system say forensics should remain a critical part of law enforcement. “Let's just give it to people as completely and honestly as we possibly can,” Saks says.

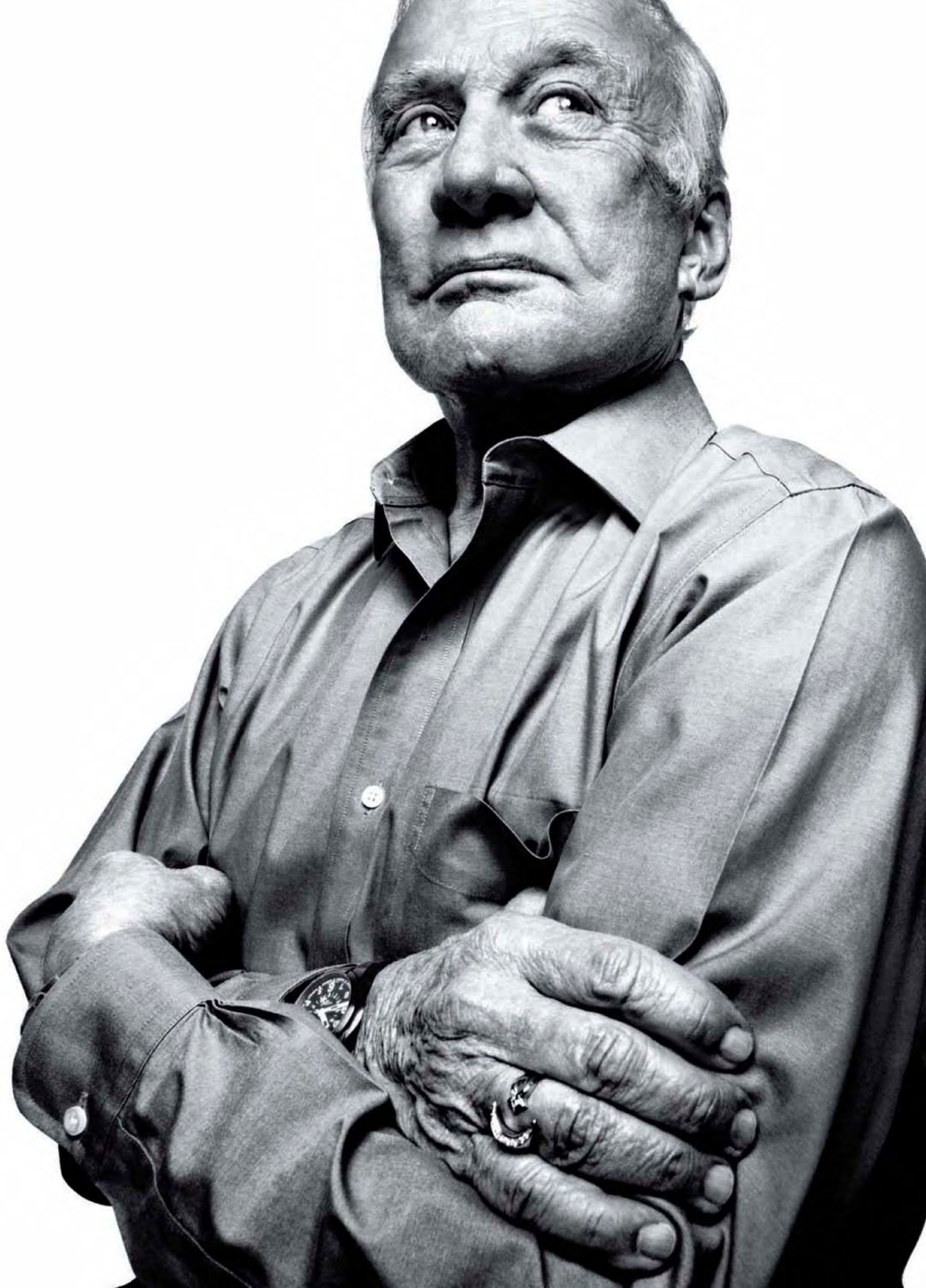
It will take years to fully reconcile the rigors of the scientific method with the needs and processes of the judicial system. But in the meantime, questionable forensic science will continue to tip the scales of justice. And when bad decisions are made in the courtroom, an innocent person's entire life can be swept right out from under him. It happened to Steven Barnes 20 years ago. Then 23 years old, he was brought to trial for the rape and murder of a 16-year-old girl. He had never been arrested before and was confident he'd be cleared. Yet he watched as forensics expert Elaine Pagliaro testified that two hairs found in Barnes's pickup were microscopically similar to the victim's. Pagliaro also noted that soil samples taken from the truck were consistent with dirt from the crime scene and even that a distinctive pattern from the victim's jeans was similar to an imprint left on the truck.

Due largely to her testimony, Barnes was sentenced to 25 years to life in prison. Last year, he was cleared by DNA and released. He'd never been on the Internet or used a cellular phone, and his girlfriend, who initially stuck by him after he went to prison, had long ago married another man. Barnes told *POPULAR MECHANICS* that he works hard not to be overwhelmed by bitterness, even toward the jurors. “They must have thought, [Pagliaro] knows what she is talking about.”

Pagliaro, a veteran analyst with the Connecticut State Police, has recently co-authored a book called *The Real World of a Forensic Scientist*. “I think this scrutiny is actually good,” she says. “It's important for the public to have a realistic expectation of what the science can do.” As for the Barnes case, there is no suggestion of impropriety regarding her testimony, but none of the evidence she presented was based on statistically validated science. “You feel awful someone spent all that time in jail,” she says. “All you can do is look back and say, ‘Was that the best we could do?’”

**PM**







# A *bolder* mission

*Apollo astronaut Buzz Aldrin has a modest proposal: Scrap plans for a second lunar space race—this time with China—and focus on the grander goal of colonizing Mars.*

**by buzz aldrin**  
*with david noland*

•  
*photograph by* **platon**

● I had a splendid career at NASA as an astronaut in the Gemini and Apollo programs. The capstone, of course, was my moonwalk on the Sea of Tranquility 40 years ago. I have only two regrets from my NASA days, and both were my own fault: I failed to speak out when I saw bad decisions being made. The first came in 1966, when NASA, in a fit of excessive caution, canceled the Astronaut Maneuvering Unit (AMU), the Buck Rogers-style jet backpack I was scheduled to try out on Gemini 12. Despite difficulties with the AMU on Gemini 9, I was very confident I could make it work. But like a good astronaut, I kept my mouth shut, and I've regretted it ever since. As it turned out, it took 18 years for NASA to develop another jet pack, the Manned Maneuvering Unit, used on three space shuttle missions in 1984.

My second bout of wishy-washiness, however, had more far-reaching implications. In the early '70s I was part of a NASA committee to establish the basic architecture of the space shuttle. One of the approaches we considered was a manned booster that would have its own pilot and glide back to the Cape after giving the orbiter its initial push. It was a silly idea—way too expensive. But I didn't object strongly enough, and we wasted a year and millions of dollars on it.

That delay and expense eventually forced a hurried decision. Instead of the customary liquid-fuel boosters like the Atlas, Titan and Saturn, which had flawless track records

Platon photographed Buzz Aldrin for PM in Los Angeles, May 2009. "It's mankind's destiny to walk on another planet," Aldrin says. "We can achieve it, but we've got to have the right plan."



on Mercury, Gemini and Apollo flights, the shuttle committee decided to go with cheaper solid-fuel boosters, which had never been used for manned spaceflight. Solid-fuel rockets are lower in performance and can't be shut off once ignited—and when something goes wrong, it tends to be catastrophic. Fifteen years after that decision, a solid-booster failure brought down *Challenger*, and the unhappy legacy of solid boosters lives on today in the underpowered, vibration-prone Ares I, the crew-launch rocket NASA is developing.

As I approach my 80th birthday, I'm in no mood to keep my mouth shut any longer when I see NASA heading down the wrong path. And that's exactly what I see today. The agency's current Vision for Space Exploration will waste decades and hundreds of billions of dollars trying to reach the moon by 2020—a glorified rehash of what we did 40 years ago. Instead of a steppingstone to Mars, NASA's current lunar plan is a detour. It will derail our Mars effort, siphoning off money and engineering talent for the next two decades. If we aspire to a long-term human presence on Mars—and I believe that should be our overarching goal for the foreseeable future—we must drastically change our focus.

Here's my plan, which I call the Unified Space Vision. It's a blueprint that will maintain U.S. leadership in human spaceflight, avoid a counterproductive space race with China

to be second back to the moon, and lead to a permanent American-led presence on Mars by 2035 at the latest. That date happens to be 66 years after Neil Armstrong and I first landed on the moon—just as our landing was 66 years after the Wright Brothers' first flight.

**NASA'S LOOMING SHORT-TERM** dilemma is the five-year gap between the shuttle's scheduled retirement next year and the debut of the Ares I rocket and the new Orion spacecraft, in 2015. During that hiatus, we'll be writing checks to the Russians to let our astronauts hitch rides on Soyuz rockets to the International Space Station, in which we've invested \$100 billion. I find that simply unacceptable.

Instead, we should stretch out the six remaining shuttle flights to 2015—one per year. Sure, that will cost money, but we can more than make up for it by canceling the troubled Ares I. In its place, we should use the old reliable Delta IV Heavy or the Atlas V satellite launchers, upgraded for human flight. (It won't take much.) Then fast-track the Orion to fly on a Delta IV or Atlas V as soon as possible.

NASA should also step up its Commercial Orbital Transportation Services program to subsidize private rockets like the SpaceX Falcon 9, which could make its first flight any time now. SpaceX is also developing the Dragon capsule to fly seven astronauts to the space station.

In the short term, some combination of an extended shuttle schedule and a new Orion/Delta, Orion/Atlas or Dragon/

## The Buzz Plan

Apollo astronaut Buzz Aldrin's Unified Space Vision is a blueprint for returning to the moon and colonizing Mars. Here are primary objectives and key craft in this epic quest.

### Short-Term Goals

Extend shuttle flights through 2015 until new Orion capsule can ride atop Delta IV or Atlas V rockets upgraded for human

flight. Promote private-sector efforts in low Earth orbit such as SpaceX's Falcon 9 rocket and Dragon capsule.

### Medium-Term Goals

Return to moon with international consortium for commercial exploitation only.

Develop runway lander based on robot X-37B and boosted by rockets like Japan's H-IIA.

### Long-Term Goals

Develop Exploration Module for manned flights of up to three years to comets, asteroids and

Martian moon Phobos, where robots prep nearby Red Planet outpost for human settlement.

Falcon would fill the gap and give us the kind of continuity and flexibility we had during the Mercury, Gemini and Apollo programs. In the meantime, we need to develop new strategies, new launch vehicles and new spacecraft for the years beyond 2015 to bring us to the threshold of Mars.

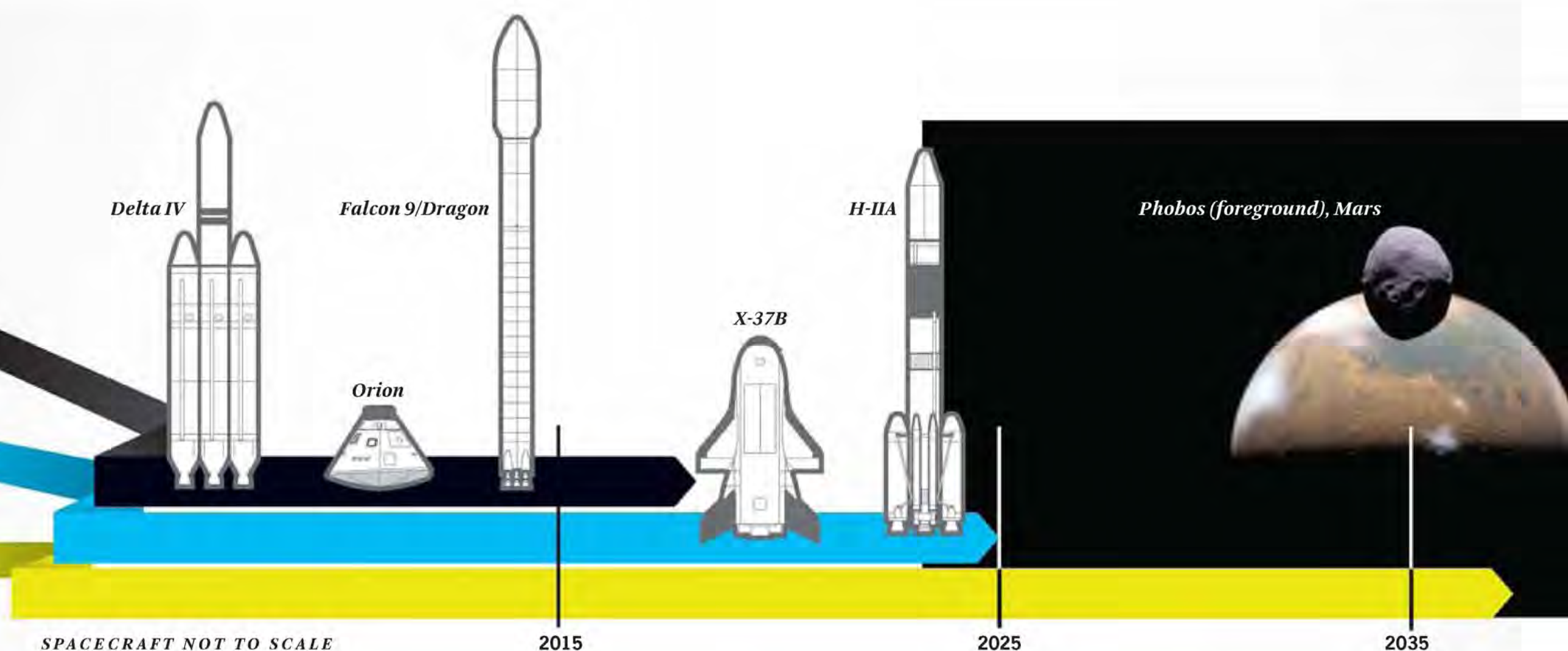
### THE KEY TO MY MEDIUM-TERM PLAN IS SIMPLE:

Scrap our go-it-alone lunar program and let international partners—China, Europe, Russia, India, Japan—do the lion's share of the planning, technical development and funding. The U.S. would participate, and we would provide the technological leadership. By renouncing our goal of being first on the moon (again), we would call off Space Race II with the Chinese and encourage them to channel their ambitious lunar efforts into the consortium. We should also invite China to join the space station partnership. Its Shenzhou spacecraft could help transport cargo and U.S. astronauts to the station.

To encourage more partners for both the lunar program and the space station, we should develop a manned spacecraft that other countries could afford to buy or lease. A compact, reusable runway lander would have broad appeal: a sort of minishuttle that could carry eight astronauts and launch atop an Atlas V or a foreign-made booster like the Japanese H-IIA or European Ariane 5. Such a space plane could be based on dormant NASA concepts like the X-38 lifting-body space-station lifeboat or the HL-20 space taxi. The Air Force's X-37B robot space plane, set for its first orbital flight later this year, could also serve as a starting point for a world shuttle.

We also need to develop a heavy-lift launch vehicle to support flights to the moon and beyond. Here is where I believe NASA's current thinking is seriously awry. After the *Columbia* disaster, the agency adopted the ill-advised policy that in future space programs, crew and cargo would be launched on separate and different vehicles. This severely limits our launch options and flexibility. The upshot of that decision is our current mess: two expensive rocket programs that have undergone numerous alterations. I've already mentioned the woes of the Ares I crew launcher; the gargantuan Ares V cargo lifter, scheduled to fly in 2018, keeps getting bigger





and more expensive with every redesign.

My alternative plan is simple math: Ares 3+3 is better than Ares 1+5. In other words, two medium-size Ares 3s would be a more efficient way to launch crew and cargo than a small crew-only Ares I and a huge cargo-only Ares V. NASA would require just one much less expensive rocket program.

This Ares 3 would use shuttle components to minimize development time and costs. Two well-studied concepts could serve as a starting point: the Jupiter Direct 232 shuttle-stack configuration developed by a group of moonlighting NASA rebels, or the Shuttle-C side-mount cargo launcher that NASA studied two decades ago. Ideally, this Ares 3 would slowly and affordably evolve to be fully reusable.

The international moon program, which I envision making a first manned landing around 2025, would eventually have to pay its own way. (We should know after a few landings whether there's any commercial or practical potential.) Perhaps we'll find ice to make liquid-oxygen rocket propellant, or the helium-3 that my fellow moonwalker Jack Schmitt believes can power future fusion reactors. Maybe a lunar solar-power station will prove feasible. In those cases, we should maintain a robotic lunar surface presence with an occasional visit by a human "Maytag repairman." If no commercial or mineral exploitation pans out, perhaps a few wealthy space tourists will pay \$100 million for a lunar flyby. If not, kill the program. Our purely exploratory efforts should aim higher than a place we've already set foot on six times.

**TO REACH MARS, WE SHOULD USE COMETS,** asteroids and Mars's moon Phobos as intermediate destinations. No giant leaps this time. More like a hop, skip and a jump. For these long-duration missions, we need an entirely new spacecraft that I call the Exploration Module, or XM. Unlike the Orion capsule, which is designed for short flights around the Earth and to the moon, the XM would contain the radiation shields, artificial gravity and food-production and recycling facilities necessary for a spaceflight of up to three years. Once launched, it would remain in space. The XM would carry attached landers designed for Phobos or Mars

and an Orion capsule for astronauts returning to Earth.

A prototype XM could be based on NASA's canceled space station Habitation Module. It could be launched as early as 2014 and attached to the space station for a long-duration shakedown test. Extended flights around the moon with second-generation XMs would serve as dry runs for its first real mission, in 2018: a one-year flight culminating in a 30,000 mph flyby of the comet 46P/Wirtanen. In 2019 and 2020, the asteroid 2001 GP2 will come within 10 million miles of Earth, in position for a month-long rendezvous with the XM. In 2021, we could try a manned approach to 99942 Apophis, the asteroid that will just miss the Earth in 2029 and has a tiny chance of hitting us in 2036. If a 2036 impact looms, we could use this mission to divert the 820-foot-wide rock.

The last step toward Mars, around 2025, would be a landing on the planet's 17-mile-wide moon Phobos, which orbits less than 4000 miles above Mars. A Phobos base would be the perfect perch from which to monitor and control the robots that will build the infrastructure on the Martian surface, in preparation for the first human visitors.

In recent years my philosophy on colonizing Mars has evolved. I now believe that human visitors to the Red Planet should commit to staying there permanently. One-way tickets to Mars will make the missions technically easier and less expensive and get us there sooner. More importantly, they will ensure that our Martian outpost steadily grows as more homesteaders arrive.

Instead of explorers, one-way Mars travelers will be 21st-century pilgrims, pioneering a new way of life. It will take a special kind of person. Instead of the traditional pilot/scientist/engineer, Martian homesteaders will be selected more for their personalities—flexible, inventive and determined in the face of unpredictability. In short, survivors.

But for this dream to happen, NASA needs to dramatically change its ways. Its myopic Vision for Space Exploration will never get us to Mars. Progressive innovation and enlightened international cooperation will. President Obama and Congress need to set NASA right—and soon.

There, I've said it. No regrets this time.

**PM**





# *fly* by wire




*Clipped to cables, riders on a new canopy*

**ZEUS HAS BEEN AROUND A LONG TIME. THIS TOWERING** eastern hemlock was here when Shawnee hunters in deerskin moccasins padded along nearby Mill Creek. It was here when Robert E. Lee rode through West Virginia, and when Gilded Age coal barons punched rail lines into this wilderness. But none of those travelers to the New River Gorge in south-central West Virginia saw Zeus the way I'm seeing Zeus.

That's because none of those guys could fly. Well, neither can I, but I'm enjoying the next best thing: I'm 85 feet above the forest floor, whipping along at 30 mph on a zipline that is carrying me and my pounding heart straight at a landing platform wrapped around Zeus's massive trunk. Verdant crowns of hemlock and white oak rush beneath my feet; I see the backs of songbirds and the glint of sunlight on gin-clear Mill Creek. And here comes Zeus, branches outstretched like welcoming arms. Move over, flying squirrels. I'm coming in.



A high-angle, aerial photograph of a person ziplining through a dense, lush green forest. The person is a small figure in the center of the frame, suspended on a zipline that stretches diagonally from the top left towards the bottom right. The forest is thick with various types of trees, their green leaves creating a textured canopy. Sunlight filters through the trees, creating dappled light and shadows. The overall scene conveys a sense of adventure and immersion in nature.

*tour soar like eagles—and help save an endangered forest.*

**BY T. EDWARD NICKENS**

PHOTOGRAPH BY  
JEFF HUTCHENS

The Treetops Canopy Tour in West Virginia has 10 ziplines—a section is seen here—strung between old-growth trees, including eastern hemlocks. Under siege by the woolly adelgid insect, hemlocks could be wiped out within decades; revenue from the tour will help fight the infestation.



Zeus is part of the New River Gorge TreeTops Canopy Tour, which opened in May. Operated by Class VI–Mountain River, the tour uses five sky bridges and two short hikes to link 10 twin-cable ziplines that offer more than a mile of high-wire flying. It takes 3 hours to complete the course. First, riders prep their junk, which is what the guides call the gear. They slip on five-point adventure-course harnesses equipped with two safety lanyards and two tandem-speed trolleys. Guides clip one trolley to the lower cable with an autolocking carabiner—each one rated to hold at least 5000 pounds—and then clip the second trolley to the top zipline. Next, they clip one of the lanyards to the lower zipline cable, attaching the other to a carabiner that rests in a groove on

top of the upper trolley. All told, riders are connected to the cables at four separate locations for maximum safety; they can nudge 30 mph rocketing from platform to platform, depending on how much they weigh. Riders place an open, leather-gloved palm on the lower zipline to brake—a palm taco, not a palm burrito, the guides explain—when they come in for a landing.

Rainforest biologists were the first to use cables and pulleys to get a better view of the canopy. Soon, canopy tours—which, unlike single ziplines, employ multiple cables and begin and end in trees—were catching on in Costa Rica and other ecotourism destinations. Class VI's course is the latest in a trend: Tours have cropped up in the forests of Juneau, Alaska, in Texas hill country and in the California redwoods. "Building a canopy tour seemed to be a natural fit for us in the transition from a whitewater outfitter to a destination adventure resort," says Class VI managing director Dave Arnold. "Elevation makes a beautiful forest that much more powerful."

When designers were inspecting the proposed course layout, however, they learned that the signature tree of this beautiful forest, the eastern hemlock, is threatened with extinction. Since 1951, the species has been under siege by the hemlock woolly adelgid, an Asian insect many scientists believe will wipe out untreated forests over the next few decades. "We had been so excited by the potential of these beautiful, big hemlocks," Arnold says. "When we heard about the WA, we were really shell-shocked for a few moments. Then we decided it was actually an opportunity to draw attention to a story that is much bigger than our canopy tour."

Since 10 of the 16 platform trees in the TreeTops course are hemlocks, guides have many opportunities to give riders a healthy dose of environmental awareness. "These trees are the redwoods of the East," Arnold says. "If this were happening in California, there would be a national call to action."

At the moment, the ecological health of ancient forests is not top-of-mind for rider Phyllis Davis, who is hugging

Zeus's trunk as if it's her last hope. She's here with five family members, and the rest of us have dubbed her the Texas Tree-hugger. Within seconds of landing on a platform, she's embracing every tree trunk like a long-lost sorority sister. "I'm not sure I can do this," she says, edging away from the tree. From Zeus to the next platform is a 390-foot zip, 90 feet above the creek. Guide Matt Rigsby clucks

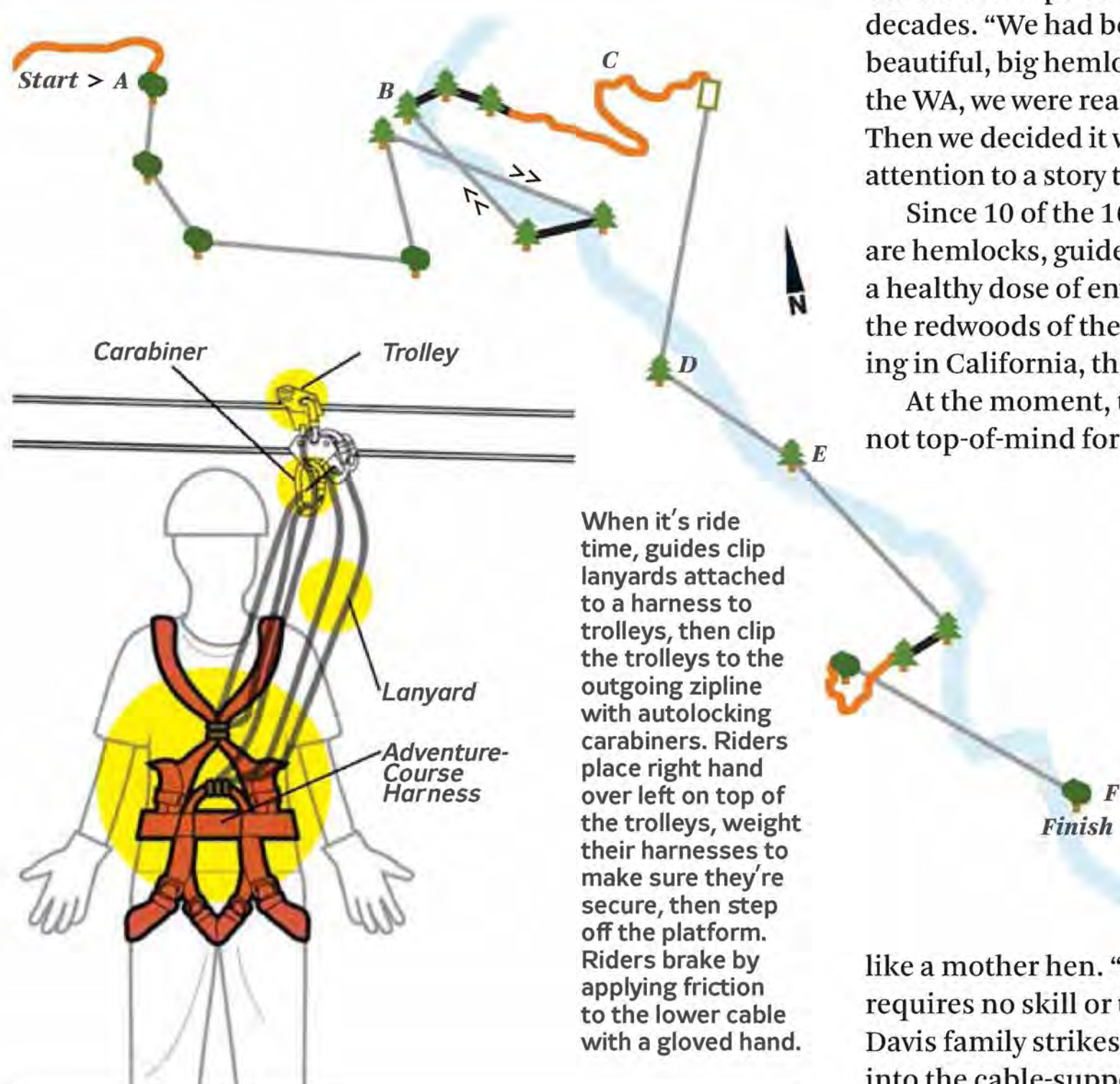
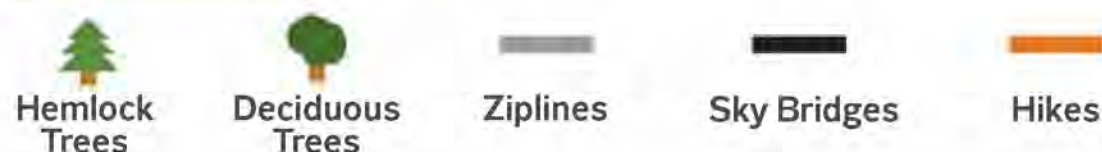
like a mother hen. "Aww, sure you can," he says. "Gravity requires no skill or talent whatsoever. Zip along now!" The Davis family strikes up a chant—Phyllis! Phyllis! She steps into the cable-supported ether and zips out of sight.

High in a hemlock, Bonsai Design founder John Walker (top) and Tyler Anderson work a platform support, called a ledger, around branches. Designed to minimize trauma to the tree, the platforms are held aloft with only four "intrusions"—or bolts—in the trunk.

## Ride This Zip

Class VI's TreeTops Tour sits high above New River Gorge and launches at Ajax (A). At Bonsai platform (B), riders cross three sky bridges and hike 830 feet (C). Riders run off a rock on their 730-foot zip to Zeus (D) and are 85 feet high on the Almost Heaven platform (E). At Double Z (F), riders complete the tour with a 35-foot rappel.

### KEY



When it's ride time, guides clip lanyards attached to a harness to trolleys, then clip the trolleys to the outgoing zipline with autolocking carabiners. Riders place right hand over left on top of the trolleys, weight their harnesses to make sure they're secure, then step off the platform. Riders brake by applying friction to the lower cable with a gloved hand.







Nutrients and water move up tree trunks via tissues called xylem. By holding cables away from the trunk, wooden growth blocks (right) keep the good stuff flowing. Fist-size cable grabs (near right) are just one example of numerous mechanisms in canopy-tour design that allow adventurers to fly safely. Opposite: A rider swoops into the bottom of a cable trough before sweep-

ing up an incline to a tree platform. "The arc and the brain have a magical connection," guide Robert Davis

says. "Speed up, slow down; repeat. We've been doing it since our mamas rocked us in the cradle."



## FLASHBACK TO EARLY SPRING—MY FIRST VISIT TO

Mill Creek. The forest floor looks like a construction site overrun by big-wall rock jacks. Rock climbers' haul bags are stuffed with cordless power drills, prusik knot loops, bubble levels, rope ascenders, cable clamps and lag screws the length of lap dogs. Giant half-circles of galvanized-steel framing lean against trees, rigged with webbing straps so they can be raised into the heavens. Above it all, I dangle like a helmeted Christmas tree ornament with three similarly harnessed figures.

A pruning saw and power drill hang from John Walker's climbing harness like a gunslinger's six-shooters. Walker is the founder of Bonsai Design, which conceptualizes and builds zipline courses. "A canopy tour," he says, "is sort of a sky trail incised into arboreal architecture that exists in a pristine state." Sparsely bearded, with bed-head hair, Walker is fond of cerebral riffs about "the geometric configuration of a gravity-based experience between codominant terminals." Designing a tour, he says, "requires a sculptural perspective. And some groovy math."

Plus architectural CAD drawings, 3D renderings and strong forearms. For weeks prior to the start of construction, Bonsai workers surveyed almost 200 trees to identify specimens strong enough to hold platform structures and as many as 10 people. Walker and a certified arborist evaluated crown health and root structure, and sounded trunks with a hammer to listen for hollows.

Once trees are chosen, Bonsai begins construction. Just getting cable aloft is a chore. Workers shoot arborists' throw balls and crossbow darts that trail braided fishing line over the forest's thicket of rhododendron and understory. The

fishing line is knotted to parachute cord, which is tied to  $\frac{3}{8}$ -inch static rope connected to heavy steel zipline cables that workers pull by hand into the high canopy. Dozens of guy trees are cabled to the platform trees to share the loads of humans zipping from the upper canopy and walking, with knocking knees, across the sky bridges. By the end of the build, nearly 2 miles of  $\frac{3}{8}$ -inch cable and a mile of  $\frac{1}{2}$ -inch guy wire spider-web the woods.

Because every tree is different, building a canopy tour is hardly formulaic. Bonsai Design's platforms are customized to fit individual trees. "A lot of design decisions are not exactly out of a textbook," canopy builder Tyler Anderson says. "It's like, 'Yo, maybe we could try it this way' and 'Dude, that sounds cool.'" Openings can be sawn into platforms to allow tree branches to penetrate the decking, or the platforms can be offset to create roomier landings and takeoffs. "We get to decide how the user will interface with each component," Anderson says, "and how the components interface with each other."

And with the forest itself. Despite its gnarly X Games appeal, the TreeTops tour treats the hemlocks with reverence. "Everything we build allows the tree to grow," says Sam Bloch, dreadlocks and carabiners dangling like tentacles. Bloch points out cables that pass through individually placed wood-growth blocks, each one hand-



sculpted with a chain-saw grinding disk to match the irregularities of the tree surface, then yoked around the trunk. Compression holds the blocks in place, and the blocks keep the cables away from the trunk—which prevents the cables from constricting growth.

Platforms are also designed with the trees in mind. Growth clamps allow the two halves of the structure's deck to open wider as the tree grows. In the 40-year life span of the platforms, Walker figures, a hemlock might add 8 inches of girth. Other species might add 40. "We have to think about the here and now *and* the years to come," Bloch says, patting the fissured bark of a hemlock. "Whatever we build still has to let this tree be a tree."

If the TreeTops tour succeeds, this forest might have the chance to remain a forest. Battling the woolly adelgid requires spraying or injecting individual trees with insecticides that can cost as much as \$150 per tree; each treatment lasts only a few years. (In the tour area, 3084 hemlocks have been tagged for treatment.) One dollar from each TreeTops ticket is earmarked for a hemlock preservation fund; Class VI matches each contribution dollar for dollar. "Right now, these trees are healthy, stalwart components of a truly wild ecosystem," Arnold says. "With revenue from the canopy tour, they'll stay that way, and we'll turn this forest into a true preserve for ancient hemlocks."

It's just the kind of groovy math, save-the-planet karma that turns up the corners of Walker's mouth. "Yes, the hemlocks," he murmurs. "There's something important to accomplish here. The hemlocks bring balance to what could be construed as a completely selfish activity."

By late April, the four-month build is over, and the

Bonsai Design crew breaks up like roadies after the house lights go up. Most take a break between canopy gigs to pursue work that makes stringing zipline cable seem as normal as a job at the bank. Anderson is off to guide climbers in Peru. Bloch works with the nonprofit Burners Without Borders, an international relief agency associated with Burning Man, Nevada's annual radical art gathering. Walker, ever the boss, has a few days of kayaking planned—then it's back to the climbing harness. He has Bonsai Design projects brewing in California, Montana and Utah.

**BY THE TIME I GLIDE ONTO THE ALMOST HEAVEN** platform—at 90 feet, the course's highest perch—I've zipped along 3430 feet of cable and teetered across five sky bridges so high I could see into squirrel nests. I'm no longer chewing on my stomach with the first step out of the trees, no longer scared to look down. Instead, I jump eagerly from the platforms. Hands off the harness, I spin in midair. I can't wait to *fly*.

When I'm once again standing in a hemlock, guide Matt Rigsby clips me onto the zip with that choreographed routine. His radio crackles with the go-ahead from the next platform: Zipline clear. The rider ahead of me has landed. Rigsby thumps me on the helmet. "There you go," he says, grinning. "You are now free to roam about the canopy." **PM**



**ON THE WEB >**

For video and photos of the course, zipping riders and the effects of the woolly adelgid, visit [popularmechanics.com/ziplines](http://popularmechanics.com/ziplines).



# HOW

# IT

# WORKS

2009 DODGE CHARGER POLICE EDITION

WITH THE RIGHT MODS, AN OFF-THE-SHELF POLICE CAR CAN BE A HYPER-EFFICIENT SURVEILLANCE MACHINE.

→ **The typical cop car isn't born**—it's slapped together. Traditionally, this involved taking a production vehicle, bolting on a reinforced bumper and adding some lights and a divider between the front and back seats.

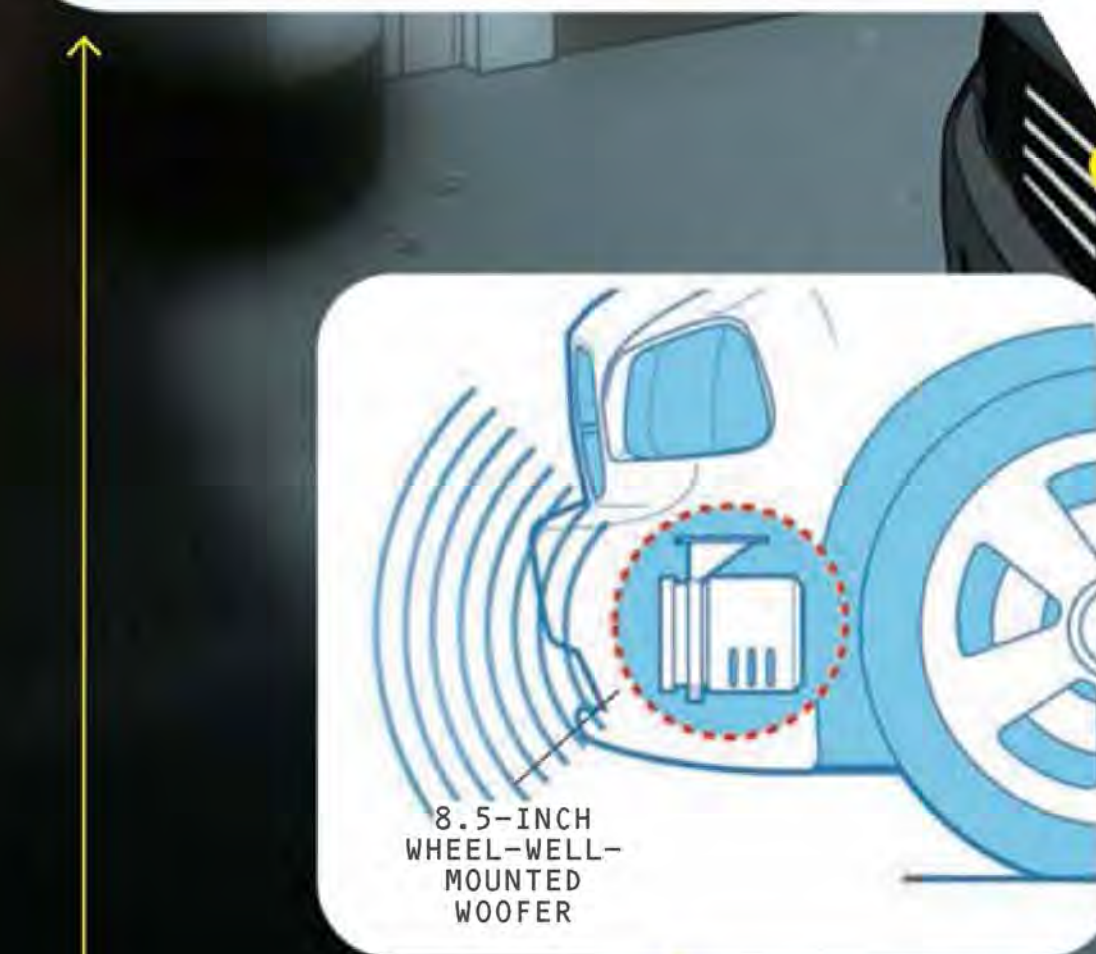
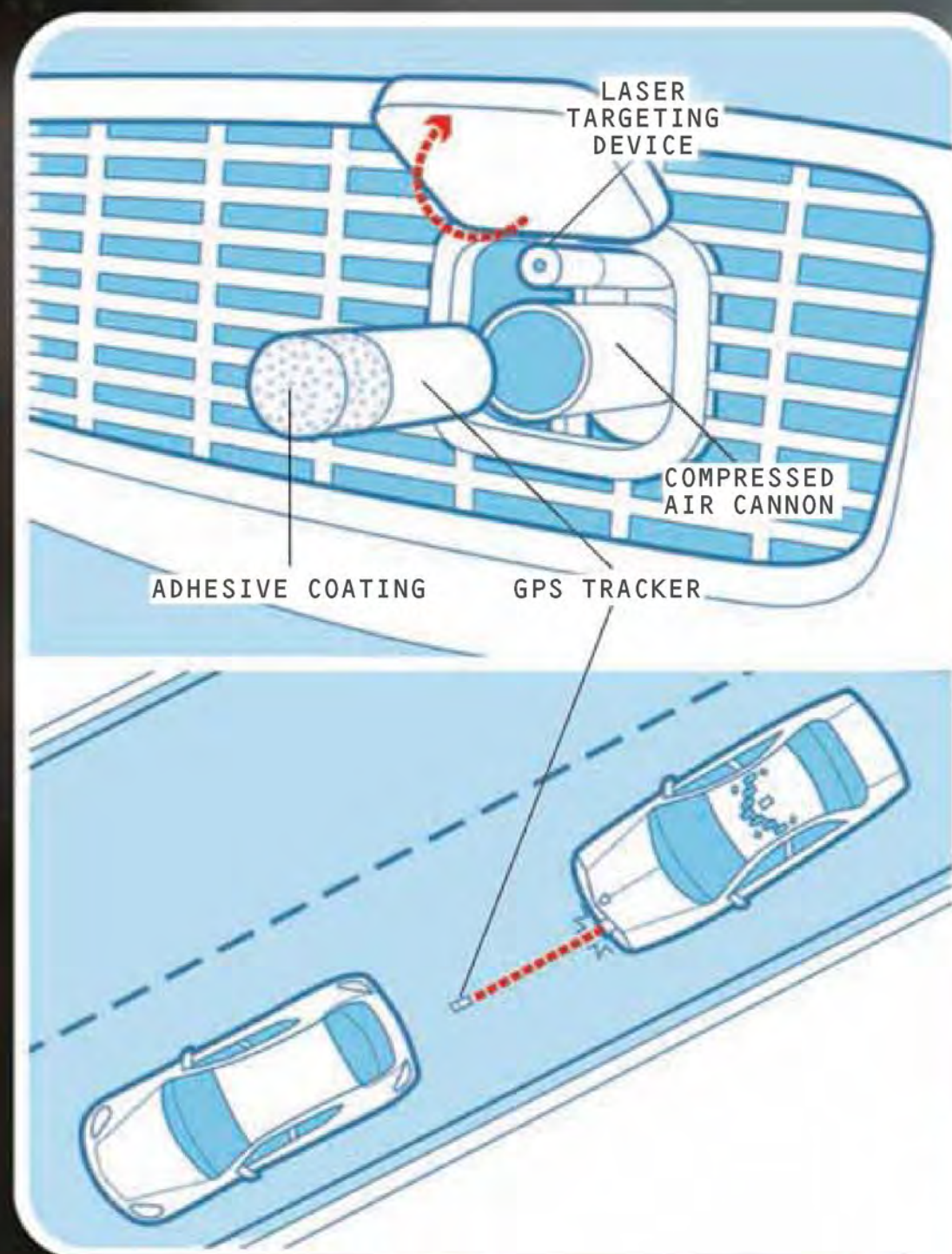
But as law enforcement agencies update their fleets, the police car is evolving. The Ford Crown Victorias of the past half-century are losing ground to more powerful models, like the Dodge Charger. (Dodge was in financial limbo at press time, but we're not giving up on the Charger just yet.) And these cars are being outfitted with gadgets that add extra eyes and ears to a policeman's arsenal.

Not all of this gear is on the road yet, but the trend is toward turning the police car into another node in an omnipresent network of surveillance sensors, capable of tracking even people who have done nothing to arouse suspicion. And this has civil liberties groups worried. "These devices allow for the forensic reconstruction of much of your life," says Lee Tien, senior staff attorney for the Electronic Frontier Foundation. "The police could go back through GPS data and plate records and know when you visited a strip club or an Alcoholics Anonymous meeting, or which political rallies or gun shows you drove to."

But those who have used the new technology say it could help protect civil liberties. "When a license plate camera looks at a plate, it's not looking at gender, race or ethnicity," says Sgt. Daniel Gomez, a member of a Los Angeles Police Department division that tests new technologies. "All it's looking for are numbers."

Whether the next generation of police cruisers will be a breakthrough for investigators, a step toward a surveillance society or a little of both, the era of the crime-fighting cab is screeching to a halt. Here's what cop cars of the future may look like. —ERIK SOFGE

ILLUSTRATION BY DON'T WAKE ME UP



## 1 GPS CANNON

A StarChase compressed-air cannon behind the grille could eliminate high-speed pursuits. Officers target a suspect's vehicle with the cannon's laser, then fire an adhesive, cellphone-size GPS tracker from up to two car lengths away, enabling dispatchers to remotely monitor the route. The LAPD is conducting field tests.

## 2 EARTH-SHAKING SIRENS

Distracted drivers and loud music can make it difficult for sirens to clear a path through traffic. The intersection-sweeping twin 8.5-inch woofers of the Rumbler system deliver a deep, rolling growl that can be heard (and felt) up to 200 feet away. The system is already deployed in Washington, D.C., and New York City.



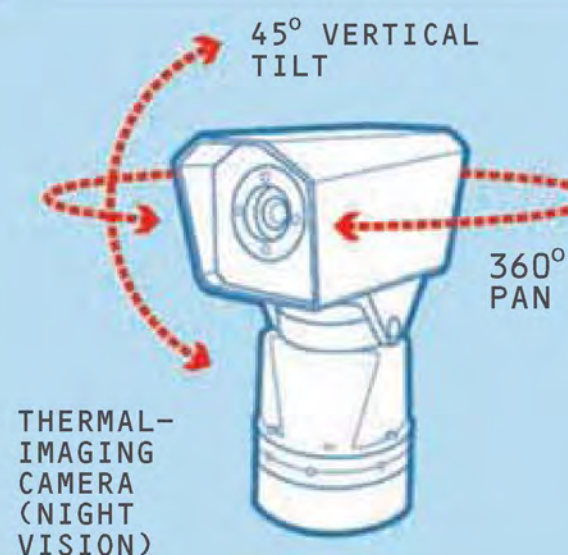
## 2009 DODGE CHARGER POLICE EDITION

### FEATURES:

- Unibody steel construction
- Multistage driver and front-passenger airbags, optional side-curtain airbags
- Interior lights shine white or red (for use with night-vision equipment)
- Rear-wheel drive

### ENGINE SPECS:

5.7-liter Hemi V8  
Horsepower: 368  
Torque: 395 lb-ft  
Fuel Rating: 16 city/  
25 hwy



### 3 V-SHAPE LED LIGHTBAR

The lightbar has evolved from a straight line of flashing lights to a wedge of low-power LEDs. The V-shape formation is easier to spot from odd angles, reducing the chance of a collision as the squad car burns through intersections.

### 4 LICENSE-PLATE CAMERAS

The surveillance equivalent of a street cleaner: roof-mounted cameras that suck license plate data from every car they pass (more than 8000 per 10-hour shift). "It can take a brand-new officer and make him a stolen-vehicles expert," the LAPD's Gomez says. An onboard computer compares the plates to a database of outstanding warrants.

### 5 THERMAL-IMAGING CAMERAS

If a suspect is hiding under cover of night, roof-mounted thermal cameras cut through total darkness, giving officers the night-vision edge of a police helicopter pilot. Advanced systems can pan and tilt, covering a full 360 degrees around the vehicle.

### 6 BELT-FRIENDLY SEATS

Car seats aren't made to accommodate bulky equipment belts. When Atlanta-based Carbon Motors' E7 cop car goes into production in 2012, it will come with specially shaped bucket seats that keep guns and gear from digging into officers' midsections.









# AFGHAN AIRLIFT

*HELICOPTERS GIVE U.S. FORCES AN EDGE IN AFGHANISTAN. BUT IT TAKES MORE THAN MACHINERY TO WIN A WAR.*

**PHOTOGRAPHS BY CHAD HUNT**

**PM EDITOR JOE PAPPALARDO**  
*RIDES SHOTGUN ON A MISSION THAT JUST MIGHT SHOW THE WAY TO AN EXIT STRATEGY.*

**THE 120 SOLDIERS SEATED IN THE GRAVEL AT FORWARD** Operating Base Zormat in eastern Afghanistan are all eagerly watching the sky. Early morning birdcalls give way to the steady thumping of rotors as two Chinooks slide into view, U.S. National Guardsmen seated at the controls, each helicopter's ungainly airframe held aloft by the beating of six 30-foot-long blades. The aircraft make wide arcs around a surveillance balloon floating over the base and then slide into parallel positions close to the soldiers. Rotor wash lashes the troops with brown dust and pebbles as the choppers settle onto the gravel landing pad.

*U.S. and Afghan soldiers exit a Chinook helicopter during Operation Thunder Almasak, a counterinsurgency sweep in eastern Afghanistan. The U.S. strategy: Help Afghans take a larger role in planning and conducting combat missions.*



## Afghan Ascent

When the men rise to their feet it's obvious they belong to two different armies. Sixty soldiers stoop under the 100-pound weight of rucksacks that jut from their backs like tortoise shells. These are U.S. Army soldiers. The other 60 men have light packs and carry old M-16 rifles or rocket-propelled grenade launchers; some heft plastic bags filled with unleavened bread, pieces of pup tents and 5-gallon water jugs. These are Afghan National Army (ANA) troops.

The two forces' disparate equipment speaks to more than just a difference in funding. It indicates two fighting styles—the U.S. Army's emphasis on individual self-reliance and discipline and the ANA's tendency to travel light with minimal planning.

Half of the Americans board one Chinook; half of the Afghans climb into the other helicopter. The ANA troops dump their gear in the cargo bay and fall into red canvas seats lining the walls. These soldiers have a tough, sad look. The old ones' faces are like weathered rock; the young ones seem curious and restless. Like most soldiers before an operation, they joke around one moment and lapse into pensive quiet the next.

The Chinooks take off, making room for a second pair of helicopters that will transport the remaining 60 soldiers into the Zormat Valley, less than 10 miles northeast, in Paktiya province. On this mission, Americans are providing the rides, but for the first time Afghans are responsible for the details of the planning. In just minutes the second pair of choppers, loaded with American and Afghan troops, takes off. Operation Thunder Almasak is underway.

**THE OPERATION'S AFGHAN SOLDIERS**—although poorly trained, ill-equipped and often illiterate—represent the exit strategy for a coalition of 42 countries dominated by the U.S. and other NATO members. For nearly eight years the coalition has tried to establish an effective national government in Kabul, but that requires a loyal Afghan army and police force that can exert control over the country.

To do so, the Afghans must counter an insurgency sponsored by the Taliban, a homegrown but Pakistani-supported fundamentalist Islamic militia that ran Afghanistan from 1996 to 2001. Insurgents receive supplies and refuge in neighboring Pakistan, then cross the border to pay Afghans to plant roadside bombs and launch ambushes. They also infiltrate villages by intimidating or killing locals.

According to current military thinking, the best way to marginalize the Taliban is to convince Afghans that the government in Kabul can protect them. If Afghan soldiers and police can persuade impoverished locals to spurn Taliban paychecks and report insurgent activity, then the government may become securely established. Operations like Thunder Almasak—a house-by-



## OVER AFGHANISTAN

*A HELICOPTER BECOMES A TIME MACHINE AS MUCH AS A METHOD OF TRANSPORT. THIS 21ST-CENTURY WAR IS BEING FOUGHT OVER 18TH-CENTURY TERRAIN. WHEN LOW-FLYING CHOPPERS BUZZ PAST, WOMEN AND CHILDREN TENDING HERDS OF GOATS GAZE UP, AND THE ANIMALS FLEE.*

house, village-by-village sweep for insurgents and weapons in the Zormat Valley—is designed to do just that. If successful, it will move the coalition one small step closer to withdrawal.

**ARMY AVIATORS OF TASK FORCE ATTACK** field plenty of requests from ground troops spread over 18,000 square miles of nearly roadless eastern Afghanistan. Most call for resupply, convoy escort or medevac flights; air-assault operations like Thunder Almasak come several times a week, when weather permits. These are the most complex missions—and the most dangerous.

The task force, a collection of scout, attack and cargo-hauling choppers, is headquartered at Forward Operating Base Salerno in Khost province, east of Paktiya. Blue-gray mountains dominate the horizon in every direction: Pakistan's ranges extend south and east; to the north and west 10,000-foot peaks separate Khost from the rest of Afghanistan. The FOB's canvas-walled, wood-floored buildings garrison about 1400 soldiers.

Like all operations, Thunder Almasak begins with a planning meeting: Six days before the Chinooks are set to take off, task force aviators gather in a one-story building close to the flight line. Capt. Donna Buono, an assistant mission planner, waits for the 30 pilots and support staff to settle down around a wooden horse-shoe table before starting the briefing. Summer heat has descended, bringing with it fat, aggressive flies. One staffer earns applause when he finds the remote control for the air conditioner.

MAP BY HAYDEXLI





An Afghan soldier in the back of a Chinook helicopter ponders an impending infiltration, which will kick off Operation Thunder Almasak. The Afghan army's gear comes mostly from old U.S. stockpiles or local markets.

Buono, a 26-year-old Apache attack helicopter pilot from Missouri, can be stormy or pleasant as the situation merits. Even hardened Special Forces personnel say they are afraid to answer the phone if they think she's angry on the other end of the line. Today her face is pinched with exhaustion, a common trait among operations captains. "Okay," she says. "This one is Operation Thunder Almasak."

On a screen at one end of the room, Buono flashes classified digital slides that describe each element of the mission. Generals at Bagram Air Base will later show updated versions of these slides to senior members of Afghan president Hamid Karzai's government for approval. It's war planning via PowerPoint.

The Army aviators usually see a fully formed ground concept when they work up their air component. But the Afghan's first planning effort is rudimentary. Hundreds of Afghan National Police and ANA troops from an Afghan army base near FOB Zormat will ride about 10 miles northeast in a truck convoy and spend five days rooting out insurgents and establishing a presence in one stretch of the Zormat Valley. Members of the U.S. 1st Squadron of the 40th cavalry division from FOB Zormat will roll with them, but inside mine-resistant vehicles.

One slide shows a map of the valley with broad blue arrows pointing in opposite directions, indicating how the troops will crisscross the valley. The crude outline is immediately dissected by two majors, executive officer Phillip Cain Baker and operations head Tom Burke. They want to know when the Afghans will move from village to village, the radio frequencies of U.S. soldiers on

the ground and the prospective landing zones for helicopters in case they are called for medevacs. The only person in the room who outranks the majors tells them not to expect many details. "Let's try to keep this simple," says Lt. Col. John White, the task force commander. "With these [ANA] guys, we have to." Buono assures the room that the Afghan planners and their U.S. advisers at FOB Zormat will provide details over the next few days.

At least the air portion is clear. Four helicopters will bring troops to two blocking positions along the valley's only road—a wide dirt path—to prevent insurgents from fleeing. Baker and Burke zero in on more possible trouble spots. How many Chinooks can fit at one time at the forward refueling stations closest to the mission's flight path? How will the timetable accommodate mandated pilot sleep cycles? What's the camera range of the surveillance balloon at FOB Zormat?

Buono scribbles details she needs to chase down. Minutes after the meeting ends, the tired mission planner is working the phone and e-mail, seeking answers.

**THE NIGHT BEFORE THE MISSION, THE PLAN** is still coming together. Afghan and U.S. ground force commanders at the ANA base near FOB Zormat gather around a topographic map of the valley. Standing in the back of the room, 1st Lt. James Covington watches silently as an Afghan general points at hilltops and villages, indicating where and when troops will converge. The infantryman pays particular attention to the heights near the northern landing zone; he and 60 Afghans under his tutelage will occupy them tomorrow.





Capt. Donna Buono climbs out of the cockpit of an Apache helicopter. For aviators with staff jobs in Afghanistan, like



Buono, flying missions is an escape from incessant planning. Lt. Col. John White, the blunt, capable commander of an air-assault task force, compares himself to the conductor of a symphony: "I work with a lot of talented people. I just have to make sure their timing is right."

Surrounded by staff who translate hand gestures into executable orders, the Afghan brass is still adding details to the vague arrows that bothered the aviators at FOB Salerno five days ago. Now a spaghetti plate of smaller blue arrows crosshatches the valley—various ANA units sealing and searching villages. The plan is clumsy, but it gives Covington hope. The 26-year-old Virginia National Guardsman and Embedded Training Team member has never seen Afghans so deeply involved in planning. ETTs spend year-long deployments training, coaching and fighting alongside Afghan troops so they can stand up to insurgents. "From what I hear," he says, "the ANA could not have done this two years ago."

Covington typically conducts operations with the Afghans he trains at another base, but he and his fellow ETTs have been called in to supervise the air-assault element of Thunder Almasak. He doesn't know these Afghan troops, which complicates his leadership challenge. "It's difficult to tell someone to do something differently when they are senior in age and experience," Covington says. "Some of these guys have been fighting as long as I've been alive."

## THE CHINOOKS TAKE OFF FROM SALERNO

just after dawn. In Afghanistan, aircraft, not pilots, have call signs. Inside Player 3, Chief Warrant Officers Mike Heuer and Lance Stafford cruise west toward the 120 troops waiting at FOB Zormat. On the headsets, behind the radio chatter of an air traffic controller, a faint

Metallica soundtrack is playing on Stafford's MP3 player.

The pilots chose the flight path days ago, but the tactical operations officer at Salerno refined the plan with Falcon-View, a flight-mission program that plots aircraft routes across detailed 3D maps. Red domes represent the range of any weapon reported in the area that could threaten a helicopter, including assault rifles, RPGs, even Soviet-era, towed antiaircraft guns.

The domes are notched where the landscape blocks the line of sight of a weapon, allowing pilots to plan a safe approach. The ground is also rendered with fidelity to give pilots recognizable landmarks. The landscape is in 3D, but most villages are shown in two. Task force planners could ask for more detailed models of the landing zone from the National Geospatial-Intelligence Agency in Bethesda, Md., but those requests add delays to already demanding schedules.

Over rural Afghanistan, a helicopter becomes a time machine as much as a method of transport. This 21st-century war is being fought over 18th-century terrain. Extended families live in unheated mud-brick buildings inside walled compounds. When low-flying helicopters buzz past, women and children tending herds of goats gaze up, and the animals flee.

The temperature inside Player 3 plummets as the yellow-green digital altitude readout ticks higher. The aircraft shudders as the engines suck thin air. In most theaters Black Hawk helicopters are the primary platform for air assaults, but they don't have the muscle to conduct heavy lifts over these mountains. Conditions in Afghanistan have promoted Chinook cargo haulers into frontline battlewagons.

Circling the landing zone at about 1100 feet, Lt. Col. White peers through his Apache's powerful daytime optics, scanning the terrain for threats. For Army aviators with staff jobs, missions are dangerous but satisfying. There are clear objectives, and the pilots have the best tools in the world to complete them. In an Apache, White can see for miles. As the commander of Task Force Attack, he's blindsided by one problem after another.

White is in one of four Apaches escorting the two pairs of Chinooks. After the troop-laden twin-rotors are launched, however, he has to divert one Apache to

*The rear gunner of a Chinook watches for threats during Thunder Almasak. On air assaults in mountainous Afghanistan, Chinooks replace Black Hawks, which cannot function effectively at high altitudes.*









*Within a minute of the air assault that starts Thunder Almasak, a U.S. sniper provides cover for Afghan soldiers taking the high ground. Americans and Afghans are inserted by helicopter to monitor road traffic while ground troops sweep villages. From these strategic perches, a skilled sniper can identify threats, disable vehicles or kill insurgents.*

escort a medevac flight. No plan ever goes off without a hitch; he hopes this is the only one.

One minute before the Chinooks reach the landing zone, the Apache pilots make the cherry/ice call. If hostiles are in the LZ, it's hot, or cherry; if not, then everything's cold, or ice. The Apaches can cool down a cherry LZ with 30-mm cannon fire or high-explosive or steel-dart-spewing antipersonnel rockets. Or, if the threat seeks refuge in a building, the pilots can launch Hell-fire missiles, designed to take out Soviet tanks but with warheads adapted to limit collateral damage.

White radios the verdict of the southern landing zone: ice. The Apaches circle over the LZ while the Chinooks descend. Inside Player 3, heavily laden U.S. troops clasp the hands of the men seated opposite from them. That way they can simultaneously pull themselves upright. The Chinook settles to the ground with a bump, and within half a minute, the experienced U.S. troops shuffle out, the first taking positions to provide covering fire if needed. The rear-door gunner reports that the Americans are safely gone.

The Afghan troops are still unloading from the other Chinook. Player 3's crew watch as a couple of Afghans

tumble down the steeper-than-expected slope as they exit. "We've got a guy with a mule," someone in an Apache reports over the radio, relaying the presence of an Afghan local. "Yeah, and we have about 30 jackasses over here," a Chinook crewman shoots back on the chopper-to-chopper frequency. Laughter crackles over the headsets. Pilots often disparage the ANA; ground forces usually have a higher opinion of their competence, or at least temper their criticisms.

Soon, the Afghans exit the second Chinook, and the two helicopters take off in an explosive bloom of dust. About 5 miles away, the Apache pilots call ice, and the other two Chinooks set down in their own clouds. The ANA troops dash out of the choppers without taking the plastic bags filled with bread and water, so the air crews toss the supplies out after them. The guardsmen are also dismayed to see the ANA troops watching the choppers instead of establishing a protective perimeter.

Two minutes tick by before the Afghans finish unloading. By this time, some have joined U.S. troops on a nearby hilltop, securing the immediate area. White circles over the disembarking troops, working the radio and scanning the terrain for threats. He sees only small



children foraging for scrub-brush firewood. White lingers until his chopper has just enough fuel to get back to base. After six days of planning and 2 hours of flying, all four infiltrations have been completed in minutes.

An hour and a half after touchdown, the troops have sealed the north-south road with two checkpoints. The ANA soldiers begin screening all car, truck and mule traffic. Hilltop observation posts protect these checkpoints with snipers and M240B machine-gun crews.

**THE NEXT MORNING HUNDREDS OF AFGHAN** soldiers start their sweep through the valley. It's been a lonely 24 hours since the air-assault troops took up blocking positions on the road, but the ground assault is right on schedule. Long convoys of Ford Ranger pickup trucks fan out from the dirt road into the villages scattered through the valley.

The ANA and police first raid areas where suspicious activity has been reported, forcibly searching homes. They are rewarded with a cache of explosives and other IED ingredients. But the ANA gain access to the majority of the walled compounds by knocking, not by kicking down doors. They make small talk with the locals and ask about conditions in the valley, and find an ambivalent but not overtly hostile populace. At times, successful counterinsurgency operations can resemble heavily armed community outreach. The number of enemy killed is not always the best metric for success.

U.S. infantry stay in the background, watching carefully as the Afghans disembark from the trucks and cord off one village at a time. Some American soldiers take positions on high ground in case of violence; a controller is in contact with an A-10 warplane overhead, ready to call in close air support. The mission's tactics show how coalition commanders want to fight this war: Train the Afghan army to repel the insurgency, while keeping U.S. troops on hand in case of emergencies.

Well-trained U.S. soldiers are not enthusiastic about letting undisciplined Afghans take the lead; strict rules of engagement add to their frustration. During encounters with the enemy, U.S. officers urge their soldiers to use "tactical patience" before shooting or calling an airstrike. The reasoning is sound: Civilian casualties sap the effort to legitimize the shaky Afghan government, and are often blamed on coalition forces regardless of the circumstances. But such caution means insurgents who are not caught in an overt act of violence often escape merely by setting down their weapons.

On the third day of the operation, the Chinooks return with water and food. They do not have to replenish ammunition—no shots have been fired.

**FROM AN OBSERVATION POST NEAR THE** northern checkpoint, Covington watches black smoke rise in the distance. After four days, things are going

## COVINGTON FEARS

*THE WORST WHEN HE SEES THE SMOKE—THE DIRTY BLACK COLOR AND A FIRECRACKER NOISE MINUTES EARLIER COULD BE SIGNS OF A ROADSIDE BOMBING. THE RADIO SOON CONFIRMS HIS SUSPICIONS: FOUR AFGHAN POLICE ON A SUPPLY RUN WERE KILLED WHEN THEIR TRUCK RAN OVER AN IED.*

well for his fellow ETT mentors and the Afghan troops. Even for soldiers who can't speak one another's language, sharing food and hardship on an extended field operation builds trust.

But Covington fears the worst when he sees the smoke—the dirty black color and a firecracker noise minutes earlier could be signs of a roadside bombing. The radio soon confirms his suspicions: Four Afghan police on a supply run were killed when their pickup truck ran over a pressure-plate-activated IED. They are destined to be the only casualties of Thunder Almasak.

By the fifth and last day of the operation, the ANA men are weary of daily foot patrols and eager to get back to their barracks. But there's more village-level diplomacy left: a meeting of locals called a shura. About a dozen men from nearby villages, including a mullah (religious teacher) and several tribal elders, hike to the northern observation post to drink tea, talk security and collect donated supplies. The fact that local leaders are willing to walk up a mountain to confer with ANA officers bestows a degree of legitimacy to the distant central government.

After the shura, the ANA troops give extra food and water to the poorest locals and hike to the Chinooks' pickup zone. Since U.S. doctrine forbids air assaults to come and go from the same spot, planners designate two new LZs. When the Chinooks deposit the Afghan and U.S. troops at FOB Zormat, the task force's role in Almasak is over. As the guardsmen clean out the back of the chopper, they find two 60-mm mortar rounds that the Afghan soldiers left behind. Even though the rounds cannot be armed until they are fired and reach altitude, the pilots roll their eyes with exasperation.

Meanwhile, back in the operations planning office at Salerno, Buono affixes a yellow and black sticker with helicopter silhouettes to a wall. She has now memorialized Thunder Almasak alongside dozens of previous air assaults. The staff will burn hard copies of the maps and radio code words in rusted metal barrels and send the most recent digital copies of the slides to Fort Rucker, in Alabama, to be preserved as a part of military history.

There are two more air-assault infils set for the week, plus exfils of ongoing operations, and more requests from ground guys stacking up behind that. Buono begins another performance around the horseshoe table: "Today, it's Operation Steel Toorah." Everyone turns to the slides on the screen, continuing the cycle of mission planning and execution. It will last eight more months, until they go home.

PM

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# DIY Home

## The Budge Factor

BIG LOADS DON'T ALWAYS CALL FOR BIG MACHINES. BASIC KNOW-HOW BACKED BY SIMPLE TOOLS CAN MOVE ALMOST ANYTHING.  
BY ROY BERENDSOHN

### Sleds

➤ Fasten a piece of plywood to construction lumber runners and you've got a sled capable of moving hundreds of pounds of rock.

STONE SLED

**The human race** is industrious, but we don't like to work any harder than we have to. The details are lost to history now, but somebody, somewhere, noticed that sliding a mammoth haunch was less tiring than carrying it. (In fact, I'm willing to bet that he noticed it slid even better fur side down.) Whether you're bring-

ing home dinner or tearing up a concrete sidewalk, easier is still better. And while some jobs might require a backhoe or a winch, you can do a lot with basic levers and rollers, built in a few minutes using some hand and power tools. The crummiest 2 x 4 stud, properly applied across a fulcrum, moves a 150-pound rock

with about 10 pounds of force. The improved version of this lever (see "Levers," page 78) is even more capable. We'll take brains over brawn any day, and the basic methods we show here will help you easily move the rocks, slabs, stumps, rubble and tree branches that you're likely to encounter.

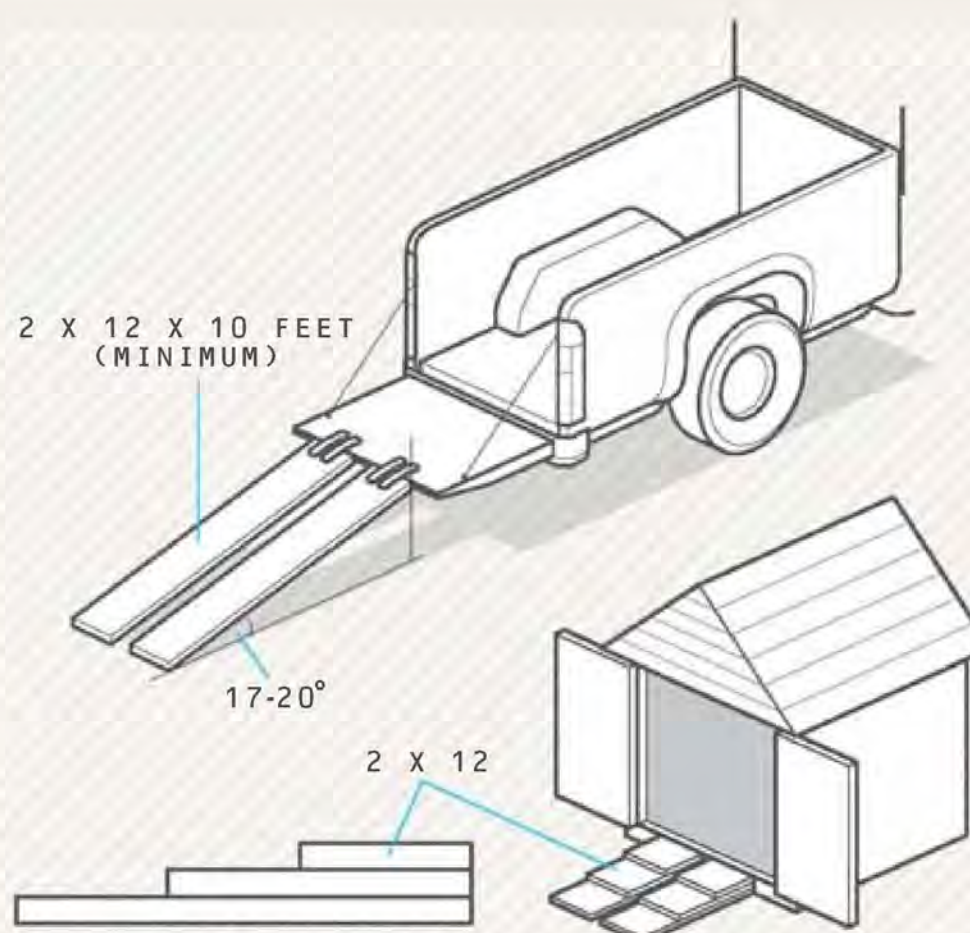


## Sleds and Ramps

**Sleds and ramps** are simple to build, and they are often the best way to move heavy stones.

A stone sled is a plywood platform bolted and screwed to a pair of 2 x 4 runners. Its low stance allows you to easily roll or pivot the load onto it. To get big stones off, pivot a bar against the side rails.

Good-quality aluminum ramps are widely used to get ATVs in and out of pickups, but rough loads can wreck them. After all, they weren't designed to withstand tumbling rocks, stumps or chunks of concrete. Instead, consider building stout ramps from 2 x 12s. The lumber needs to be a minimum of 10 feet long—this will produce an angle of about 17 degrees, for a typical pickup-bed height. That doesn't sound very steep, until you push a loaded wheelbarrow up it. Improve traction by applying some paint to the ramp surface, preferably stuff you would have otherwise thrown away. Sprinkle dry



sand on the wet paint or use antiskid paint additive (\$7 to \$15 per container). Improve traction by stiffening it with a 2 x 4 spine nailed vertically on edge to its bottom surface.

A "step ramp" sounds oxymoronic, but it's well-suited to its name—a hybrid between ramps and steps. Build a pair. Each consists of extremely shallow steps made from 2 x 12

### Ramps

#### ← Slippery Slope

Sure, you can buy nice ramp hardware that mounts to construction lumber, but you can easily make your own from steel flat stock. Use carriage bolts to attach it to 2 x 12s.

#### ← Problem Solver

Somewhere between ramps and steps is the step ramp. Just face-nail short pieces of 2 x 12 lumber to create a versatile load mover.

chunks face-nailed together. They nest together nicely and tuck unobtrusively into the corner of a shed.

In rare instances, a load forms its own transport. Years ago, the owner of a tree company showed me an old-time Yankee trick. To move a big pile of brush, place a Y-shaped branch on the ground, curved side down, and stack the brush on it. The branch's stem forms a convenient handle, and the curved trunk acts like a sled runner.

### Rollers

#### → The Can, Can

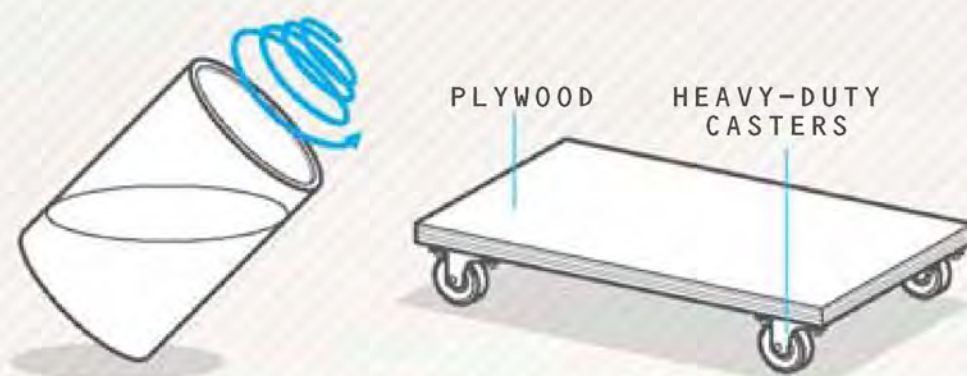
Any round trashcan rolls on its bottom edge. Plastic ones also slide nicely.

#### → Dolly, Wood

Bolt a piece of 3/4-inch plywood to four heavy-duty dollies. No plywood? Use construction lumber and cross cleats.

#### → Pipe Line

PVC pipe (Schedule 40) and construction lumber team up to move heavy loads. This technique is particularly well-suited to soft or wet terrain.



## Rollers

**If sliding is easier** than carrying, rolling is easier than sliding. Tip a rubble-filled garbage can onto its corner and you've created an effective way to move rubble around a remodeling job. The can's large diameter lets you apply



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a surprising amount of torque.

Everybody knows the trick of rolling a heavy load on pipes. The method works better when you roll the pipes over lumber, not on ground. Also, putting the load itself on lumber makes for a smoother action.

If you need to move a big load like a chest freezer over a smooth surface, make yourself a four-wheel dolly. Moving companies are likely to own varied dollies—with raised ends, raised sides or flush platforms. For a homeowner, a couple of smooth-platform dollies are the most useful. You can always make riser blocks as needed to suit the bottom surface of the load you're rolling. Use swivel-plate caster wheels, not the pin types designed to be

installed in furniture legs. The casters should be rated for at least 150 pounds each. That might strike you as overkill, but keep in mind that the caster rating is based on an evenly distributed load moved over an ideal surface. That almost never happens. So the real-world carrying capacity of the caster is much less. Large wheels (4 or 5 inches) roll more easily over rough surfaces than 2- or 3-inch wheels, though they are slightly more difficult to load, since they make the dolly a couple of inches taller.

## Levers

**Simple levers** are all around us, from wrecking bars to pieces of lumber to shovels and tree branches.

The chisel-tip (or pinch-point) wrecking bar is one of my favorite load movers. To get the most out of it, pivot it against a firm, angular fulcrum—the best is a piece of 4 x 4 staked in place with 2-foot-long pieces of rebar.

For hands-free prying, the bar teams up nicely with my other favorite, a heavy-duty shovel. The shovel's back forms a curved fulcrum for the bar. Lay the shovel face down in the same direction as the bar, then get the bar tip under the load. You can step on the bar's end to lift the load, leaving your hands free to work.

A Johnson bar is a wheeled lever. It's a favorite among movers and millwrights, and one of the best contraptions for moving stuff ever invented. The one I made lacks wheels, but it's no less useful. Take a 1½ x 48-inch piece of mild-steel flat stock and clamp the end in a machinist's vise. Then put a stubby 30-degree bend in its end. Bore a row of countersunk holes through the flat stock and attach the metal to the edge of an 8-foot-long 2 x 4 using No. 10 wood screws. Now cut a fulcrum radius on the bottom corner of the 2 x 4. Hook the end of the flat stock under a load, and when you pry back you'll be astonished at the way the load just floats off the ground. **PM**

### Levers

#### → Bar Exam

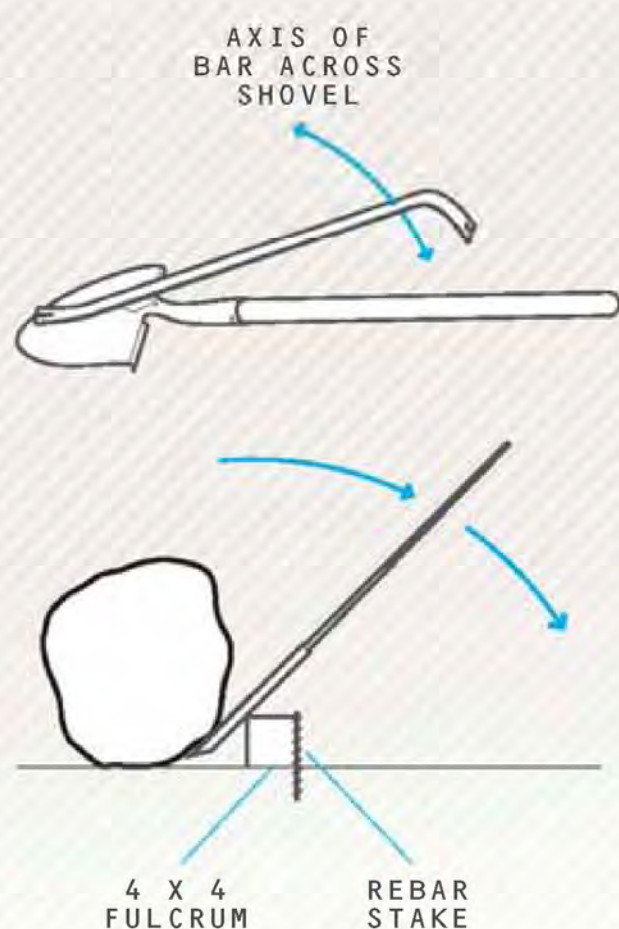
A heavy-duty shovel's back forms the perfect fulcrum for a wrecking bar. Face the two tools in the same direction, and get the bar tip under the load. Then just step down on the bar.

#### → Rock, Roll

To get the most from your fulcrum, keep it from moving by staking it in place with rebar.

#### → Lever Lift

It's easy. Use hefty wood screws or even bolts to attach a bent piece of steel flat stock to the end of a 2 x 4.





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## Classics: Simple Do-It-Yourself Projects

### Beyond Your Basic Bench

AN EASY WEEKEND WOODWORKING PROJECT THAT PAIRS A STYLISH SEAT WITH STORAGE.

At several spots in our home, I've thought aloud, "Boy, wouldn't it be great to have a seat right here?" And, just as often, "Boy, wouldn't it be great to have a storage space right here?" Besides the troubling realization that I'm always talking to myself, it became clear that our home needed a convenient spot to sit to remove shoes, and more places to keep things like hats and gloves. To alleviate both problems, I built this simple wooden bench, which features a hinged top above a surprisingly spacious storage compartment. The 14 x 36-inch seat is plenty wide enough to accommodate two adults. I painted the clear pine bench and fastened its top to the rear apron with a 30-inch-long continuous hinge. A feature that's especially important if you have children around is the spring-loaded lid support, which prevents the top from slamming onto fingers.

by JOSEPH TRUINI  
photographs by ANJA HITZENBERGER







1



2



3



4

## Cut, Fasten, Finish

Cut two 34-inch-long aprons from 1 x 6 pine. Make a cardboard template of a curve, then trace the shape onto each end of both 1 x 6 aprons [1]. Use a saber saw fitted with a fine-tooth blade to cut the curved shape. Sand the cut ends smooth. Rout a 1/4-inch-wide by 3/8-inch-deep stopped groove into the inside of each apron, 1/2 inch up from the bottom edge [2]. The grooves will hold the plywood bottom of the storage box. Next, rip two 10 1/2-inch-wide legs from a pine 1 x 12. Adjust the table-saw blade to 15 degrees and crosscut the legs to

↓  
PROCESS



5



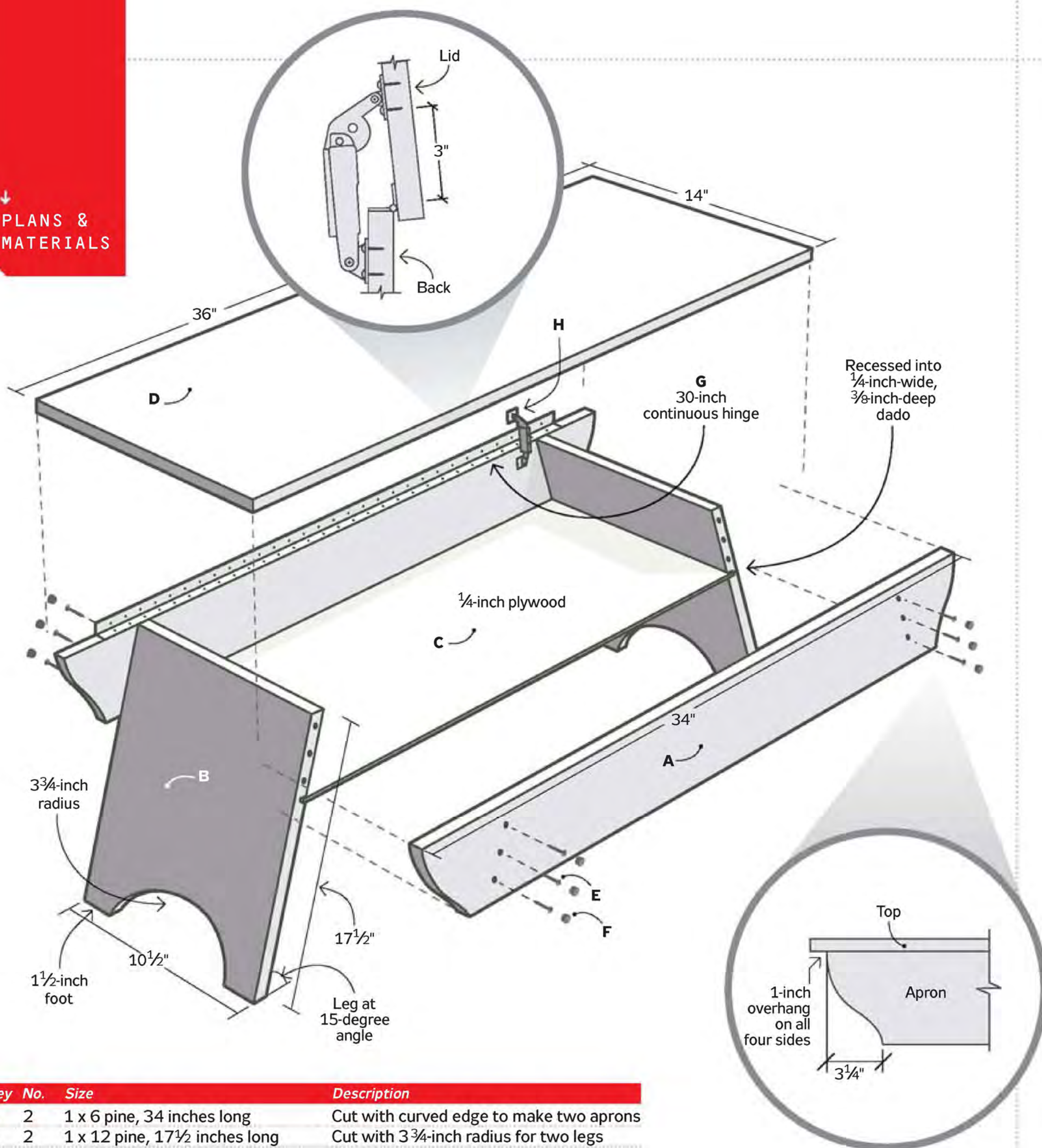
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17 1/2 inches. Lower the blade for a 3/8-inch-deep cut. Pass the leg over the angled saw blade to cut a dado into its inside surface to accept the plywood bottom [3]. Make two or three passes, moving the fence each time, to create a 1/4-inch dado. Use a compass to mark a 3 3/4-inch radius onto the bottom end of each leg. Adjust the saber-saw shoe for a 15-degree bevel cut. Saw along the curved line to create an arch in each leg [4]. Hand-sand the cuts with 80-grit sandpaper. Fasten the front and rear aprons to one of the legs with six 1 5/8-inch drywall screws driven through

3/8-inch counterbored holes [5]. Insert the 1/4-inch plywood bottom into the grooves, and use six more screws to install the remaining leg. Glue plugs cut from 3/8-inch dowels into the holes, sand them flush, then putty over them before priming and painting. Cut the bench seat to 14 x 36 inches, and attach it to the rear apron with a 30-inch-long hinge. Center the hinge on the apron, make starter holes with an awl, and fasten the hinge. To keep the bench top from slamming shut, add a lid support about 2 1/2 inches from the right leg. Fasten it to both the bench top and the rear apron [6]. To give the bench an aged appearance, use a rasp or sanding block to rub through the paint along the lower edges of the legs' corners. Apply wood stain to darken the exposed wood edges, and wipe away the excess with a clean cloth.



## PLANS & MATERIALS



Key	No.	Size	Description
A	2	1 x 6 pine, 34 inches long	Cut with curved edge to make two aprons
B	2	1 x 12 pine, 17½ inches long	Cut with 3¾-inch radius for two legs
C	1	Sheet ¼-inch plywood, cut to 11¼ x 24½ inches	Use as the bottom of the bench storage box
D	1	¾-inch pine shelving plank, cut to 14 x 36 inches	Cut to make the seat at the top of the bench
E	12	1⅝-inch drywall screws	Attach legs to front and rear aprons
F	12	⅜-inch-diameter dowel plugs	Use as plugs to cover countersunk screw heads
G	1	30-inch-long, 1⅝-inch-wide continuous hinge	Attach bench top to rear box wall
H	1	Toy-box lid support	Holds bench top up when opened to access storage

## Tools

Saber saw with a fine-tooth blade, router with ¼-inch straight bit, table saw, pencil compass, ⅜-inch-diameter countersink bit, awl, drill/driver, 3-inch foam trim roller, 80-grit sandpaper, foam brush.

**Bench Dressing**  
GIVE THE BENCH SOME STYLE AND VISUAL INTEREST WITH ONE OF THESE IDEAS.

→ **Stenciling** Use stencils to paint a geometric design on the bench top, aprons and legs. → **Wallpaper** Soak the paper in water, wait a few minutes for the adhesive to activate, then apply wallpaper to the bench top. Trim the paper flush with the edges, and apply a coat of polyurethane varnish. → **Picture Perfect** Glue a poster or print to the bench using contact cement.



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# Homeowners Clinic

by Roy Berendsohn

Q + A



## The Big Fix

**Q** We bought a foreclosed house from a bank. While it's in pretty good shape, the place is riddled with drywall holes, some of them pretty big. We want to get started painting ASAP. What's the fastest and best way to repair these holes, especially the big ones?

→ tools and materials



pencil



drywall saw



utility knife



drywall compound



drywall knife

**A** It's no big deal to fix drywall holes. Years ago, when I had a job doing condo maintenance, I developed this method for repairing large holes in walls. First, cut a neat drywall patch. Make it generously oversized, relative to the hole. Next, hold it over the hole and trace neatly around the patch with a sharp pencil. Take a drywall saw and cut on the outside of the pencil line. Now take the patch, drive two drywall screws into it to serve as handles and test fit it in the hole. If the patch doesn't fit, here's a down-and-dirty trick: Put your thumb about midway behind the blade of the saw and scrape its teeth sideways over the patch's high spot. The coarse teeth plane down the edge of the drywall. If the ridges left by the teeth need to be shaved off, flip the saw over and do the same move with the back of the saw.

Finally, butter the edge of the patch like it was a brick, and simply set it into the hole. Wipe off excess drywall compound with a 6-inch knife, but don't bother being too fussy. Come back after the compound is dry and sand

the repair smooth. Apply compound as needed to blend it into the surrounding surface. I've skipped the drywall tape on most repairs and haven't seen problems with them. But I'd tape a really big repair—say, a patch that is 1 foot square. Drywall tape is even more important for a durable repair if the patch is located in a zone that could see additional abuse, such as where a doorknob may strike.

With modifications, the same procedure can be used on ceilings, as our editor-in-chief, Jim Meigs, found while helping his son do some volunteer work recently. Use a strip of drywall inserted into the ceiling cavity and screwed to the patch. This acts as a brace that holds the repair up while the drywall compound hardens.

For small holes in a wall, simply slap on a peel-and-stick drywall patch. You can also use a method in which you cut out the patch but carve away the drywall around the perimeter so the patch's paper forms a flange. Put the patch in the hole and apply compound over the paper flange.



Cut a neat, generously oversized patch and trace around it.



Using a drywall saw, cut on the outside of the line.



Drive in two drywall screw "handles," apply compound to the patch edges and insert it.



## Barbecue Damage

**After a recent cookout, we were cleaning up the patio area. When we moved the grill, we were surprised to find that some of the vinyl siding on the garage wall was discolored. A small spot had melted. I also found that some grease had escaped and stained the new brick pavers.**

If the affected area is very visible, you can take some siding off a less noticeable location and use it to make the repair blend in. Then replace the siding with new pieces in the inconspicuous spot. This is obviously more work than simply replacing the damaged siding with new material. Your call.

In the future, place the grill well away from the wall to guard against a fire hazard. In addition, put the grill above a mat to reduce grease stains on wood or masonry. If you have a composite deck, be sure the mat is rated for use on composites—some mats can get stuck to the decking when left in place for long periods. Also, the mat will shield the area under it from sunlight and hold in moisture (and possibly seed pods and bug nests). This results in a darker area below the mat, relative to its surroundings. That might be an issue someday if you replace the mat with a smaller one.

## Disposal Hassles

**When my husband and I took some toxic stuff to the transfer station run by our town, we were surprised to find that the town wouldn't take old paint. It did take the solvents and brake cleaner and other stuff that was left in our shed by the house's previous owner. So how do we get rid of the paint?**

Easy. Go to a paint store or a home center and buy a few pouches of solidifier that's rated for both latex and oil paint. Mix the stuff into the paint with a stirring stick, and leave the stick standing up in the can to

form a convenient handle. The paint will turn into a block and can be disposed of, can and all, with other household trash.

## Deck Debacle

**I hate the way my old, shabby deck looks so much I'm tempted to take an ax to it and start over. Last summer, I stripped it clean and applied a coat of topnotch paint. Now it's peeling.**

**How can I fix this?**

First, decide whether it's time to replace the deck boards with synthetic materials, which in many cases either need no finish or will bond tenaciously with finishes specifically designed for them. Put these down, and your coating problems are solved. For composite decking that you'd buy off the rack at a home center (nothing fancy, in other words), expect to pay \$4 to \$5 per square foot.

If replacing the decking is cost prohibitive, and you opt to strip the deck, roll on a heavy coat of water-based paint stripper. Scrape up the resulting goo, and when the debris is dry, dis-

pose of it. Next, pressure-wash the deck, or hire a pro to do it for you.

Unfortunately, you've learned something the hard way. Paint doesn't do well on horizontal lumber surfaces, especially when the surface is pine or other softwood with a pronounced latewood grain pattern (the wood cells that form during the peak of the growing season). Latewood cells are dense and resinous, and paints or solid stains don't stick to them well. To make matters worse, these grain patterns predominate on the surfaces of most types of pressure-treated softwood decking.

After the deck boards are installed and painted, rainwater (or snowmelt) sits on the deck, absorbs into the wood, and then gets baked out by the sun. The water vapor lifts the paint, which hasn't formed a good bond with the flat-sawn, latewood grain pattern.

The solution is to apply a stain and preservative rated for decks. Don't use a solid stain (similar to paint), or one that's meant for application on vertical surfaces, such as siding and fences.

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## The Not-So-Great Wall of China

**Keith Baker noticed sour smells** emanating from the walls of his newly built home in Fort Myers, Fla., soon after he took up residence there in March 2008. Then, he says, the copper pipes from the hot-water heater turned black, "as though someone threw soot on them." Soon Baker and his wife started experiencing sinus problems, dizzy spells and muscle aches. They are among thousands of homeowners in Florida and elsewhere who are blaming such problems on low-quality, imported drywall.

Domestic supplies of the building staple ran short during the building boom of recent years, which was compounded in coastal areas by post-hurricane reconstruction projects. Contractors used 540 million pounds of drywall from China between 2004 and 2008, according to shipping records surveyed by the Associated Press. The office of Sen. Bill Nelson of Florida estimates that the material may have ended up in as many as 100,000 homes nationwide. Lab analyses obtained by the Florida Department of Health show that the gypsum in some Chinese drywall contains strontium sulfide, a material absent from most samples manufactured in the United States. Scientists suspect that this compound, which releases sulfurous gases, could be the cause of

homeowner complaints that range from nosebleeds and respiratory ailments to black coatings tarnishing shower fixtures and corroding air-conditioner coils.

Researchers say the evidence isn't conclusive—and point out that not all Chinese drywall is suspect. However, a number of class-action lawsuits have been filed. Builder Lennar Corporation has identified dozens of houses containing potentially harmful drywall, and has pledged to fund the only known remedy: removing the drywall, replacing damaged plumbing and wiring, and relocating homeowners until new materials are installed. In a sure sign that fear is spreading, con men have started hawking bogus test kits and remedies such as chemical sprays and ozone generators.

Homeowners worried about their own wall material can check for a "Made In" stamp or a manufacturer's name on exposed board backs. If no name appears, the Florida attorney general's office recommends an inspection by the builder or a licensed contractor. Meanwhile, the U.S. Consumer Product Safety Commission is investigating. "We need to see what's going on," representative Joe Martyak says. "We will pursue this aggressively but scientifically." — ADAM HADHAZY



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## Post Modern

**We're remodeling an old farmhouse, and one of the most difficult things to deal with is a post in the middle of the living room. Can we remove it?**

Probably—but consult an architect before you pick up a wrecking bar. The post is carrying a load from the roof and floors above to somewhere below, and the route that the load takes through the structure (known as the load path) has to be redirected. The architect will examine the house and then specify the size and location of a beam that will take the load, as well as any additional framing that needs to be done. This may involve tearing open walls and ceilings, and moving electrical and plumbing lines. Done properly, it should be worth the time and trouble. You'll end up with a nice old house that has a better floor plan.

## Sinking Pavers

**We have a brick-and-sand walkway leading to our front door. Last year, some of the bricks sank and I reset**

**them. This year, more sank, and some of the ones I replaced last time sank again. Now what do I do?**

Brace yourself. It's time to decide whether or not to take up the entire walk, replace its base and reset the pavers. There are two major reasons that pavers settle this way. The walk's base may not be up to the job (it may not be thick enough, or perhaps it was not properly compacted). The other possibility is that the soil below is settling.

In most parts of the country, a brick walk is set on 3 to 6 inches of compacted crushed stone (or limestone) with 2 to 3 inches of compacted sand above that. But those specifics can

vary widely depending on where you live. It's tough to put down a brick walk in regions that have severe freeze-thaw cycles or soil types that shift easily. Those regions may require a base that's twice as thick as what I outline here. To find out what construction is typical where you are, make some calls to masonry supply yards. Next, calculate the volume of materials you will need. Remove the existing walk, arrange for material delivery when the removal is complete and, finally, rent the necessary equipment and rebuild. Good luck. For a complete look at the process, see "Installing a Brick Walkway" at [popularmechanics.com](http://popularmechanics.com). **PM**

---

**GOT A HOME-MAINTENANCE OR REPAIR PROBLEM?** Ask Roy about it. Send your questions to [pmhomeclinic@hearst.com](mailto:pmhomeclinic@hearst.com) or to Homeowners Clinic, Popular Mechanics, 300 W. 57th St., New York, NY 10019-5899. While we cannot answer questions individually, problems of general interest will be discussed in the column.

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## Clean It Up

PROTECT YOUR INVESTMENT—MAKE THE FINISH ON THE EXTERIOR AND INTERIOR LAST AS LONG AS THE MECHANICALS. *BY MIKE ALLEN*

**Guess what?** The median age of cars on the road is creeping up. But thanks to industry-wide improvements in quality, cars are more reliable than they were only a decade ago. One hundred thousand miles was the watershed number that

labeled a car as “old” back in the day. Now, it’s not uncommon for a vehicle to last twice that many miles before something too expensive to fix forces it into the scrap yard. That’s the good news. Here’s the bad news: The paint, body and interior have twice as

much time marinating in the elements to lose that factory-fresh patina and start looking like Jed Clampett’s pickup. So how does a vehicle’s condition affect its market price? We looked up the trade-in value of a 2000 Honda Accord with



100,000 miles at *edmunds.com*. The site says that in excellent condition, it's worth just about five grand in trade. Downgrade that rating to average and you'll lose over \$2000. Here's how to protect your investment—and maximize its value down the road.

## Scrub Down

**Cars get dirty.** But there's more than just dirt and rain spots clinging to your car's exterior. Airborne industrial pollutants, acid rain, dead bugs, tree sap and bird droppings can all degrade the paint. Modern car finishes are all covered with a clear coat to protect the pigmented main layer, but even this UV-resistant outer layer will last longer if you maintain it. Keep things clean and waxed to repel water and pollutants.

The same goes for your car's interior. That slimy patina of French fries, Big Gulp, sweat and dirt will eventually turn your interior into a primordial swamp. Shampoo the cloth seats to remove all that gunk. Now, forget what you think you know. There's nothing under your kitchen sink that's appropriate for washing or cleaning your car, except maybe the glass cleaner. Leave the dish detergent for the dishes, and use a proper car-washing solution. Clean the window glass last to catch all the oversprayed cleaning products.

Leather seats deserve a proper leather cleaner, followed by leather conditioner to replenish the skin's natural oils. Save the protectant for the dashboard. I strongly recommend against using protectant on the steering wheel and rubber pedals, because it can reduce your grip to dangerous levels.

Park in the shade while washing and waxing to prevent the heat of the sun from drying off the car and making water spots before you can dry them. Wet the surface beforehand to help dissolve the bug stains and loosen the dirt. Hose the salt and mud off the wheel wells and undercarriage.

Clean the wheels first to keep all the slop from getting on the bodywork.

## → IMPROVE YOUR VISION



exterior  
care

Hazed-out plastic headlights are not only ugly, they're dangerous. We're using a Mothers PowerBall and plastic polish to make our old lights look new. Mask the area to keep from polishing off the surrounding paint.

## → WHEELS AND TIRES



Wet down the wheel and tire, then spray or brush on the wheel cleaner. Use a soft brush to get in where the brake dust hides, then hose down. Lather, rinse, repeat—then dry the water spots off with a clean towel. Follow up with car wax.

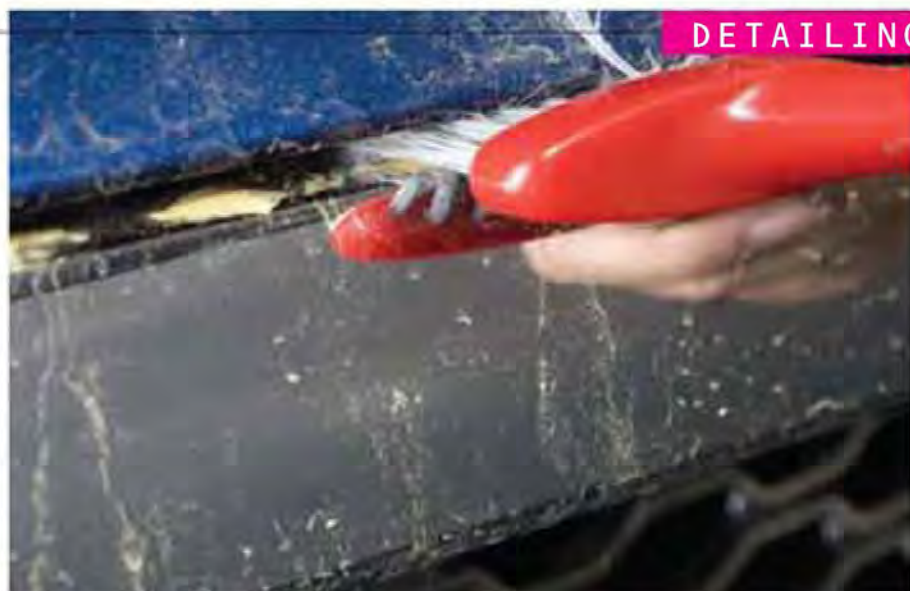
## → BARE METAL



Much of what you think is polished metal on today's cars is actually either chromed plastic or painted and clear-coated metal. Lightly polish an inconspicuous area for a few seconds. Bare metal will leave dark gray residue in the polishing cloth—no gray means you're polishing clear coat. That's bad. Hand-polishing works fine, but we saved a lot of time on some aluminum wheels using a PowerCone on a cordless drill. Follow up with, you guessed it, wax.



An old toothbrush or a specialized detailing brush will get crud out of cracks. Be sure the vehicle is dry before waxing.



DETAILING

I owned a black car—once. And it's a commitment to keep it looking primo. Turtle Wax's Black Box has special cleaners and, no kidding, black wax that won't leave white residue in every crack.



BASIC BLACK

Hazed-out paint will usually recover if you use a good chemical-cleaner wax. If your car has clear-coat paint—most cars made since the '90s do—look for a product labeled "clear-coat safe." Abrasive compounds are great for non-clear-coat paints on older cars.

Use the same trick I described for metal polish to check if your paint is clear-coated. Rub a hidden area of the paint surface with compound. If the rag picks up any body color, there's no clear coat.



FINISHING TOUCHES

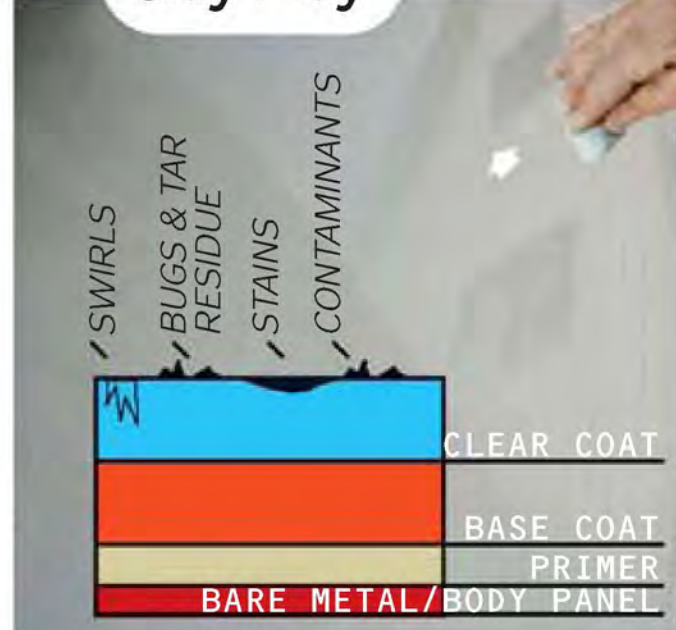
Grayed-out plastic trim can make your ride look old before its time. Protectants will help, but won't last out in the sun. We used Mothers Back-to-Black cream to restore this car's trim. Forget about using black shoe polish. Don't ask how I know this.



BLACK TRIM

## PROBLEM SOLVED

### Clay Play



#### Neglected paint can

haze out and collect surface contaminants that chemical-cleaner waxes can't improve. Try a clay bar, an old detailer's trick.

Start with a thorough wash to remove abrasive dirt. Then spray the clay kit's lubricant over a few square feet of panel. Knead the clay bar to soften it, and run it over the surface in straight lines. Flip the bar over and rub at right angles. Keep the surface wet. It should take a good hour to clay a typical car. Follow up with a wash and wax.

Rinse the wheels down, but wax them with the rest of the paint. Now you can wash the car all over with a lambswool wash mitt, drying it with chamois, terrycloth or microfiber towels. Save the diapers—they're too abrasive.

The gold standard in wax used to be hard-to-apply paste carnauba wax. You know: Wax on, wax off. Modern chemistry has reduced wax to nano-size particles, added synthetics and generally made wax easy to apply and remove. We also like quick detailers for everyday use. Follow up a quick wash and dry with a light spray of detailer and wipe down with a microfiber towel for months of protection from the environment. Final step: Clean up any water spots on the windows inside and out.

PM



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Q + A

## Car Clinic

by Mike Allen

The pins on a noid light (used for testing fuel injectors) match up with the pins on your fuel injectors.

## Lights On

**Q** My car has become very unreliable. It often won't start. Yet by the time I get it towed to the shop, it's fine. I can't tell if the problem is the ignition or the fuel injection. Is there some easy way to tell if the injection is working?

**A** Tackle this one systematically. If the engine has fuel, spark and compression, it will start. Does the fuel pump work? You should be able to hear it run for a few seconds after turning on the key. Is there spark? Get a spark tester and confirm there is a spark across the gap of the spark plug. Is the injection delivering fuel? You can pull an injector and check that it's spraying, but a simple test of the injection system is called—I kid you not—a **noid light**. And no, I don't know why it's called a noid light. Anyway, this

simple test uses a small bulb mounted in a case. The bulb has contacts that mate the harness to the injector. Unplug an injector, any injector, which probably won't take any tools at all. Plug in the noid light, and prop it up so you can see it from the driver's seat. Crank the engine, and the light should flash. If it does, you've confirmed power to the engine computer and data coming to the ECM from a half-dozen different sensors. Yes, you can do this with a digital multimeter, but it's sometimes hard to back-probe those





injector connectors, and it's not a good idea to probe the female pins, because they're easy to damage. The noid light is just a simple, inexpensive go or no-go test.

## Oil Spill

**My daughter has a 2001 Ford Explorer with 90,000 miles on the clock. It runs great. However, when I changed the oil I found coolant in it—yet the coolant level is full. In my many years on this planet I have never seen this happen.**

**What is going on?**

There are three alternatives:

1. Someone is pouring coolant into your oil-filler cap.
2. Coolant is leaking into the oil. And it's probably from a bad head gasket. (Of these two alternatives, I'd bet on

the second. As to your claim that the coolant level is still full, it only takes a small amount of coolant in the oil to look like a lot of coolant in the oil.)

**3.** It's not really coolant, but condensation turning into a mayonnaise-like goo and collecting in the cooler parts of the crankcase, including the inside of the oil-filler cap. This is a problem during extremely cold weather, and in vehicles that are used for urban service and never warmed up for a long enough time to force the water out through the crankcase vent system.

## Long-Life Lights

**I have a 2005 Chevy Tahoe Z71. The third brake light is out. I went to the auto parts store and they sold me the bulbs. I removed the light assembly from the truck but cannot find any**

**way to open it so I can replace the bulbs. Is there a way to do this? Or, do I need to replace the entire unit? It would seem crazy to replace an \$80 part to change a \$1.50 bulb, no?**

You need to go back to that auto parts store. The CHMSL (Center High Mounted Stop Lamp, if you must know—hey, it's the DOT's terminology, not mine) on your truck is populated with light-emitting diodes (LEDs), not replaceable incandescent bulbs. It's a sealed assembly, and you can't replace the LEDs yourself. If that sounds crazy, just remember that the customary life span of those LEDs is far longer than the life span of your truck. And I doubt that every single one of the dozen or more LEDs soldered into that assembly is fried.

Check the wiring. Check the fuse for the third brake light, which is different from the fuse that controls the brake lights in the car's body. It's a 10-amp fuse labeled "CHMSL" in the fuse panel. By the way, this fuse also feeds the brake-light circuit in the trailer connector, so if you've been towing trailers with funky electrical systems—which is most of them, it seems—it may well be blown.

## ABS Anecdote

**While replacing a broken wheel stud on my girlfriend's 2005 Chevy Cobalt, I had to unplug the ABS wiring located above the spindle so I could pull out the hub. I plugged the two connector ends together after putting the hub back in place, but now the ABS light on the dash panel is lit. She is sure it wasn't on before I did the work, so I was wondering if a temporary illumination of the light is normal after it is unplugged?**

That light would go out on its own if the ABS sensor was working. I'm always skeptical when people tell me that none of the warning lights were on before an (attempted) repair. I always start any diagnosis with a short scan-tool session, downloading trouble codes and browsing for problems—not all of which will make a light come on. Also, I'm curious. What exactly happened to this car that caused the broken wheel stud? Those studs are stout, so anything that could break wheel

■ YOU NEED THIS

## Pulling the Wires



**We've discussed** the procedure for removing an old steel spark plug that's installed in an aluminum head before. It ain't easy. Last week I had to change a set of plugs that hadn't been touched for 15 years. The hardest part was actually removing the spark plug wires to access the plugs. The rubber boots had stuck to the porcelain insulator, and refused to let go. Pulling on the wires will just leave the boot and metal cap stuck on the plug. And the rubber boot acts like a Chinese handcuff—pulling harder only tightens its grip. I had to go back into the toolbox and get my special plug-wire pliers. The secret? Grip the boot with these pliers, pull a little and twist a lot. This will break up the adhesion. The small flange on the base of the pliers will lift the boot from the bottom. — M.A.



studs could have inflicted collateral damage in that entire corner of the car. Check the clearance between the sensor and the tone wheel. Try swapping a different sensor in that corner if one of the others will fit.

But I'd start by removing the connector, swabbing it out with some electrical contact cleaner and putting it back together.

## Properly Mixed

**I accidentally poured some windshield-washer fluid into the radiator. My coolant mix is two-thirds water, so will the washer fluid hurt the radiator? Or should the radiator be drained and filled with new coolant?**

First off, your mixture is incorrect. The coolant mix should be 50/50 coolant to water, not 33/67. That combination will provide your engine with the proper compromise of good cooling, freeze protection and proper additive concentration to fight corrosion in the cooling system.

Exactly how much windshield-washer fluid did you add, and what kind? Winter-grade washer fluid is 70 percent alcohol, which has a boiling point well below the water or coolant. More than a few ounces in the system could lead to a boilover as you're traveling uphill on some hot day. Summer-grade fluid has less alcohol and is basically just water, a little surfactant and blue dye. If your cooling system is really two-thirds water and a quart or so of alcohol-based washer fluid, you need to flush and refill it with the right stuff.

Next time you remove a cap and it says "use 50/50 mix of coolant and water," take note. They're not telling you how to make a margarita.

## Exhaust Plug

**A friend of mine took his 3-year-old pickup in for an oil change. The mechanic talked him into a \$52 fuel-injector cleaning. Within two weeks, his catalytic converter plugged up to the point that his engine would barely run. His dealer confirmed that the problem was a plugged-up converter and changed it under warranty. I wonder how many others have gone through the same experience. In your opinion,**

### NEWS FLASH

## Corrosive Condition

**Owners of some 2000 to 2001 Toyota Tundra Pickups have filed complaints with the National Highway Traffic Safety Administration (NHTSA) about excessive corrosion—rust—that has caused potentially dangerous cracking in the frame. This follows in the wake of Toyota's voluntary buyback of an undisclosed number of Tacoma trucks a year ago with similar problems. Toyota spokesman Brian Lyons said its investigation had just begun, but that the complaints involve a "small" number of vehicles—all of which were from states that use salt on the roads during winter. — M.A.**

### is there any problem using injector-cleaning additives?

I have to think the injection-cleaning procedure was not followed properly, damaging the converter. Your friend is lucky the dealer fixed it for free.

I don't recommend routine injector cleaning for vehicles that are running properly. There are two classes of injector-cleaning machines: on-car and off-car. The on-car style requires the mechanic to clamp off fuel lines and isolate the fuel rail. Then a concentrated cleaning solution is pumped in and the car is allowed to idle for 20 minutes or so, burning the cleaning solution instead of gasoline. Not following the injector-cleaning-machine manufacturer's directions can make the engine run too rich or misfire, and literally slag down the inside of the catalytic converter.

A more expensive way to clean injectors involves removing them from the manifold and installing them in a device that recirculates a powerful solvent through the injectors as they sit inside a clear chamber where you can

watch the spray pattern and measure the flow. This procedure can't damage the cat, because the car is likely on the other side of the shop while the injector work is done. Any injector that has a low flow rate or a poor spray pattern will have to be replaced.

Most cars don't need periodic injection cleaning. An occasional bottle of injector cleaner or an occasional tankful of Top Tier gasoline (which has more detergents than the EPA requires) should do the job.

On the other hand, if your driveability or fuel economy has dropped off, and the problem doesn't seem obvious, a session on one of these machines might help. At least if it's properly done.

## Plastic Pistons

**I need to replace the rear brake pads and caliper on my 1999 Jeep Grand Cherokee. The counter guy at the local shop asked me if I wanted the part to be phenolic or stainless steel. I called my Jeep specialist and he didn't know there was a choice—and wasn't familiar with the term "phenolic." Have you done comparisons between the reliability of phenolic versus stainless steel?**

Most brake calipers have traditionally used hydraulic pistons made of hard-chrome plated steel. Steel is a good match for the cast-steel caliper. Neglected vehicles, and those operated in wet, salty environments like the seashore or the Midwest, can have problems with the corrosion of the steel as well as with flaking, pitting chrome. Eventually, the corrosion interferes with the movement of the piston in the caliper bore. Then it's time for a rebuild.

A few years back, some car manufacturers switched over to pistons made of phenolic resin—i.e., plastic—to reduce corrosion and weight. As a side benefit, the pistons transmitted less heat from the friction material in the pads to the brake fluid. And that reduced fluid breakdown.

Some mechanics didn't like the plastic pistons, because they couldn't really be reused. For many vehicles, you have the choice of replacing a caliper with a rebuilt unit that uses the original phenolic, or steel. I actually prefer the lighter plastic ones. **PM**





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# DIY Tech

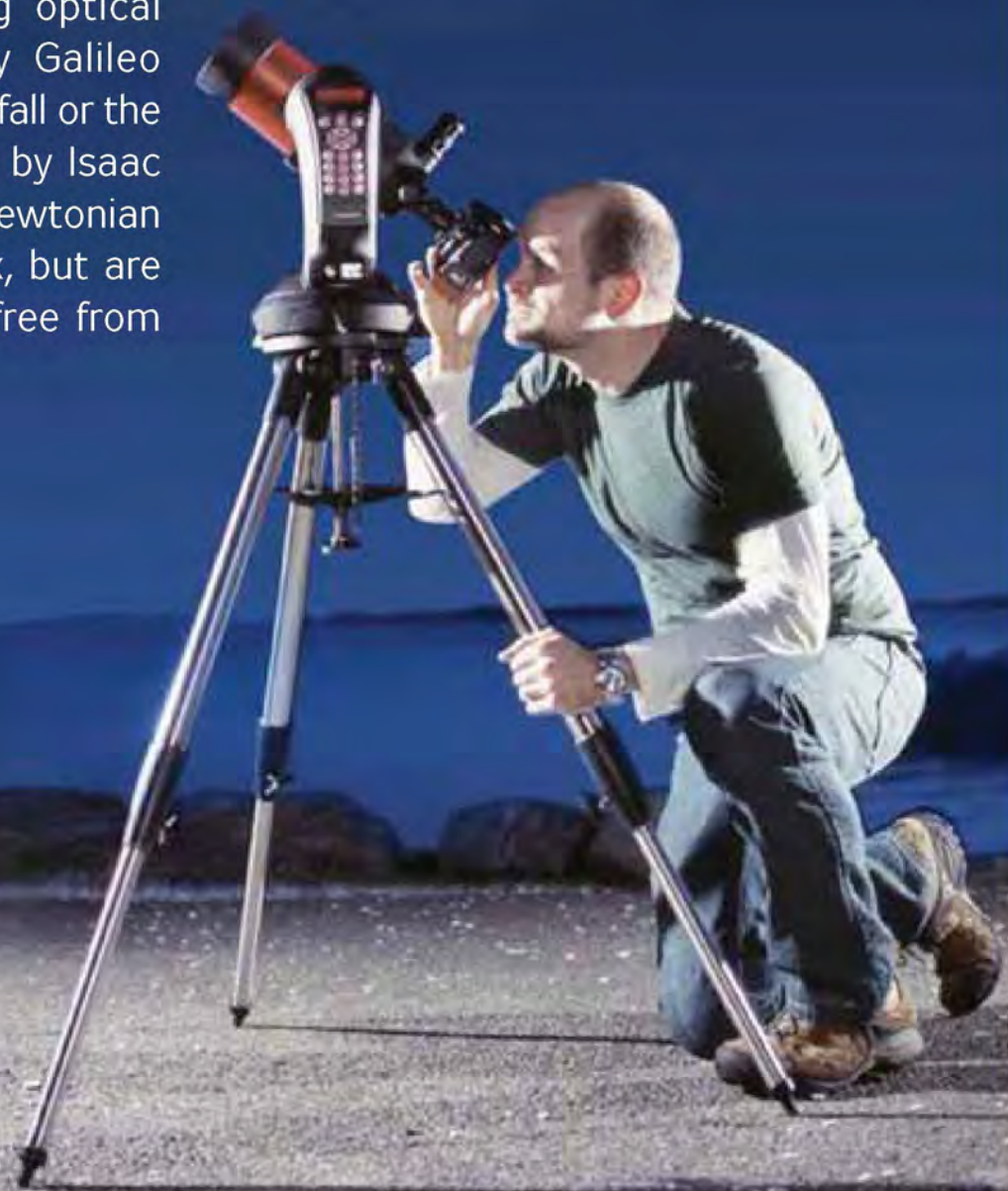
## Digital Space Exploration

COMPUTERIZED TELESCOPES OPEN AN EASY WINDOW TO THE STARS. BY GLENN DERENE

**Astronomy is** one of those pursuits that becomes as complicated as you allow it to be. It can be as effortless as lying on one's back, stargazing in an open field, or it can be an intense study of celestial objects that consumes the better part of a lifetime. Telescopes reflect this variety of interest and experience. Entry-level

models can be had for less than \$200. These beginner scopes are decidedly nondigital, relying only on a user's understanding of the sky and either the refracting optical technology pioneered by Galileo exactly 400 years ago this fall or the reflecting optics invented by Isaac Newton 63 years later. (Newtonian scopes are more complex, but are also more compact and free from

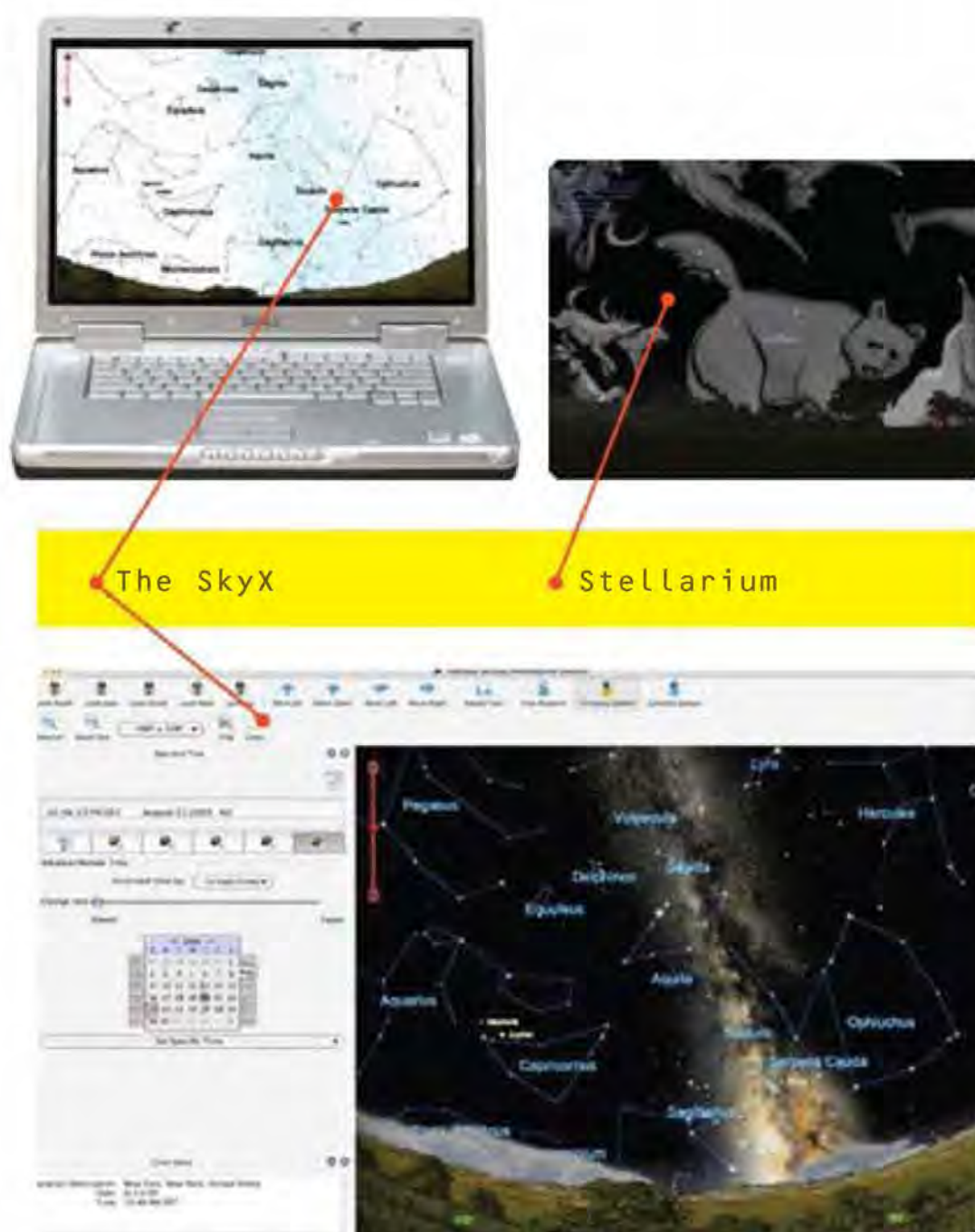
August is well-known for the Perseid meteor showers (which are visible to the naked eye on the 12th). Also, train your scope all month long on Jupiter and the constellation Sagittarius.





## Mousing the Heavens

**Astronomy software** makes exploring the night sky a point-and-click experience. Programs such as the SkyX Serious Astronomer Edition (\$144) from Software Bisque and Stellarium (free) make it easy to find celestial objects visible from your location. By using an adapter cord (many telescopes ship with serial cables; USB adapters are usually accessories), you can use your PC to control your telescope.



the chromatic aberration caused by refractors. Sorry, Galileo.) Prices only go up from there. If you really get serious about astronomy, you can throw fistfuls of cash at your pastime for better and better optics, motors, mounts and digital goodies such as GPS and full digital guidance and control.

With all the various options, it can be hard to know how to get started. Do I want an altazimuth or equatorial mount? Should my mirror configuration be a Schmidt-Cassegrain or a Maksutov-Cassegrain? What kind of coatings should my optics have? I'm going to risk the furor of astronomy enthusiasts here and say that, for the beginner, most of this doesn't matter. You can start getting persnickety if and when you become interested enough to buy your second telescope. To start off, you want just enough magnification from the combination of your scope and eyepiece to bring out the detail in the moon and nearby planets and to reveal the stars just beyond the grasp of the naked eye (75x to 200x

will do). That will give you material for years of astronomical exploration.

## Guidance Systems

Many of the fancy mechanics found in high-end telescopes may be out of both the price range and expertise of beginning astronomers, but much of the digital technology associated with astronomy offers maximum benefit to novices. The easiest digital aids are the Celestron SkyScout and the Meade MySky (both cost \$199). These devices have integrated GPS, plus orientation and positioning sensors that help users identify and locate celestial objects by pointing at them. Neither device requires a telescope, but they make using an analog scope easier.

More sophisticated telescopes with onboard computers almost entirely automate the navigation of the cosmos, eliminating the need for star charts and reference books and drastically reducing the learning curve associated with understanding what's what in the night sky. In the telescope world,

a step up in digital capability doesn't hit the wallet as hard as a step up in optical quality. Entry-level computerized scopes from makers such as Celestron, iOptron, Meade and Orion sell for under \$500, but better lenses and mirrors can easily double that price. With their built-in databases of thousands of stars and their battery-operated motors, these computerized telescopes are designed to be quickly and easily aligned, after which they can automatically find and track celestial objects.

As remarkable as the technology is, the setup is not always as straightforward as you might hope. The mid-level Celestron NexStar 4 SE (\$599) that I tested has a "SkyAlign" feature that instructs the user to input the time, date and location (telescopes with built-in GPS simplify this part of the process), then point the telescope at any three bright objects in the night sky. The computer figures out the rest. Sounds simple, but in practice it can be hard to decide which objects are bright enough to qualify. The moon is an obvious candidate, but it can take a few minutes to get two stars or planets in your field of view to round out the trifecta. The problem is as old as telescoping itself—your eye has a far wider field of view than a telescope—and the greater the magnification of said scope, the narrower its window on the sky. Plus, a star that seems to stand out in a section of inky blackness when viewed with the naked eye is often revealed to be surrounded by other stars when you look through the telescope. I often found myself hunting for a star that I was sure was right in front of my scope. (Many of the latest advances in telescope technology are aimed at making the alignment procedure easier. Meade's new LightSwitch system claims to be able to align using a single bright star.)

Once your telescope is aligned, its onboard computer can tour you through the many wonders of the night sky. Select Saturn from a list of planets, and whirring motors kick in, slowly swinging the scope around to aim at the ringed planet. You can also browse constellations, or type in a code of any one of thousands of space objects.

Touring the greatest hits of outer



space with your computerized telescope can be quite a kick—it's akin to channel-surfing the heavens. Nevertheless, the term "computer control" is a bit generous for the keypad operation of most scopes. The standard-issue, multibutton controllers and alphanumeric screens are a far cry from the "what-you-see-is-what-you-get" graphical user interfaces of modern PCs.

## The Connected Scope

To marry the capabilities of a telescope to the powerful interface of a personal computer, you'll need the right software and the right cable. Many telescopes ship with an RS-232 serial cable and a software package. So all you have to do is hook up the cable to your computer's serial port and ... What's that you say? Your computer doesn't have a serial port? Actually, most new computers have abandoned this antiquated connection, but few telescopes ship with cables that plug into the far more common USB ports. So be prepared to purchase a \$20 to \$50 serial-to-USB adapter cable.

The software that ships with many computerized telescopes can utilize your PC for telescope control, but often that just means mimicking the scope's keypad on your screen and giving you access to interactive digital maps of the night sky. Third-party software offers point-and-click telescope control integrated with those interactive maps. Stellarium, a free, open-source digital astronomy guide and control program, is good, but may require installation of extra drivers. The SkyX Serious Astronomer Edition (\$144) is a more full-featured program, seamlessly marrying telescope control with virtualized navigation. Once you sync your telescope and enter the time, date and your location into the program, the interactive map aligns to the stars, planets and other celestial bodies currently above you, then slews your telescope to whatever you select. See it onscreen, then look at it through your scope a few seconds later.



**Attaching a digital SLR camera** to a telescope is a bit like outfitting your camera with a 1000-mm to 4000-mm (depending on your scope) super-telephoto lens. But telescope photography offers none of the hand-holding, auto-focus, auto-light-metering and vibration-reduction features found in modern lenses. To hook up your SLR, you'll need a T-ring adapter specific to your brands of camera and telescope. Astrophotography often benefits from long exposure times, so a properly aligned telescope with a motorized base is necessary to track celestial objects as they move through the sky. Also, consider getting a shutter remote to keep you from jiggling the camera. Dial in your camera's manual setting, turn off any automatic noise reduction, then focus using the telescope's controls. — G.D.

## Shutter on the Sky

When you think about it, telescopes are really nothing more than elaborate telephoto lenses for the eyes, so it should come as no surprise that they can play the same role for a camera. To that end, most telescope manufacturers sell T-ring adapters that attach to the lens mounts of common SLR cameras. Plus, some Newtonian telescopes, such as my NexStar 4 SE, allow users to flip the mirror inside the scope to bounce the image through a separate porthole where the camera mounts.

But be aware—attaching a modern digital SLR to a telescope can give your camera some cognitive dissonance. DSLRs are designed to communicate digitally with their lenses, and when attached to a mount with no data stream, they naturally conclude that the user is trying to shoot a picture with no lens attached, which can result in an error message. That

means that you're going to want to switch your camera to manual settings mode and focus using the telescope.

What makes computerized scopes so useful for celestial photography is that they are designed to automatically follow objects through the sky to counter the Earth's rotation. Since photographs of space objects naturally benefit from long exposure times, such images would become unrecognizable smudges without a motor-driven tracking system. Like every other aspect of astronomy, telescope photography is served by a wide variety of specialty software, filters and equipment. Real devotees can abandon a camera altogether in favor of a CMOS or CCD imager that is controlled directly by the telescope. (Depending on the resolution and sophistication, these can cost anywhere from \$99 to \$800.) With each improvement in skill and equipment, you'll get a deeper dig into the universe. **PM**



extreme freebie

## Win This Telescope!



Have you ever looked up at the night sky and had the sneaking suspicion that there was more to the universe than your straining, stretching, unassisted eyes could see? It's true! Lunar craters, comets, satellites, planets and many other celestial wonders are hiding a few levels of magnification deep within the cosmos—and we want to give you a better view. That's why we're giving away a Celestron NexStar 6 SE Computerized

Telescope, valued at \$999, to one lucky winner. It has a 5.91-inch aperture, 1500-mm focal length and a maximum useful magnification of 354x. With an onboard computer and built-in motor, the NexStar 6 SE can automatically locate and slew to any heavenly body from its 40,000-object database. After a look into outer space through these glorious optics, you'll never want to let your eyes go naked again.

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# CRUTCHFIELD



## Digital Clinic

by Seth Porges

Q + A

✚ ATM skimmers use cameras, such as those in cellphones, to capture PINs. The cameras hide behind false grilles or mirrors. The data can be wirelessly transmitted to a PC.

connected laptop hidden nearby, or sent to another computer via a 3G wireless card. In some cases, the mag-stripe reader is placed next to the ATM's actual card slot, which is covered with an "Out of Order" sign. The false reader also may be placed directly over the real card slot, sucking up data as the card passes through to the bank's machine. When this happens, users get cash and a receipt as if nothing had happened.

While nobody knows just how many ATM skimmers are out there, reports have been surging. Over the course of just one week in April, at least three were discovered in Washington Mutual/Chase ATMs around the country. And in May, four Romanians were arrested on charges of setting up skimming devices on multiple machines across New York state, reportedly allowing them to wire almost \$2 million in stolen funds back to Eastern Europe. The same week, the NYPD discovered another skimming operation, this one set up on multiple Sovereign Bank

ATMs in Staten Island. The total take: more than \$500,000 from more than 250 victims.

The banks acknowledge that skimmers have become a problem. "We have security and fraud teams investigating these and other incidents that have come to our attention," Christine Holevas, a spokeswoman for Chase, says. "But consumers need to know that they are not liable for any charges or withdrawals they do not make."

Unfortunately, the barrier of entry for would-be thieves is low. "A criminal can do a simple Google search,

## Automatic Theft Machines

**Q** I've heard about ATM skimming devices that can steal my card information. How do I spot one?

**A** When Brooklyn, N.Y., resident Nick McGlynn stepped into a Chase bank in April, he quickly noticed something was wrong with one of the ATMs. "I saw a mirror that looked out of place," McGlynn says. "It was in the center of the ATM, above the keypad. So I pulled on it and it came right off. Then I pulled on the card reader and it came off too. They were both held in place with double-sided tape."

McGlynn had discovered an ATM skimmer—a device attached to an ATM by criminals looking to steal bank card information and PINs. The sim-

plest skimmer setups involve little more than a \$300 magnetic-stripe reader and a hidden camera aimed at the ATM keypad. The reader snaps up your card's information, and the camera records your PIN as you enter it. With this information, a perpetrator can create and use a phony plastic clone of your card. If the setup features a camera aimed at the reader to record the security code printed on the card, criminals can also use the information to make online purchases.

All the information gathered is stored either on a memory card or a







Security cameras captured images of suspects in an ATM skimmer operation. This crew, which operated out of Staten Island, N.Y., is suspected of having stolen upward of \$500,000 from more than 250 victims before the scam was discovered in May of this year.

spend some money buying parts on eBay and within a couple of days have a fully operational card-skimming operation in place," says John Pironti, president of digital-security consulting firm IP Architects.

Because these parts are often cobbled together from various sources, few ATM skimmers look exactly alike. The camera could be from a cellphone, the battery an off-the-shelf lithium-ion cell. Criminals aren't interested in creating a polished device—just something that works well enough to steal information for a few hours or days before it gets discovered and removed.

So how can you spot a skimmer? "If it looks like something's been attached, snapped or glued onto the ATM, that's a warning sign," Pironti says. "ATMs are pretty straightforward, so if something looks physically wrong, it probably is."

"Be vigilant at ATMs," says special agent Malcolm D. Wiley Sr. of the Secret Service, which is tasked with investigating bank fraud. "Visually and physically check the machine. Most skimmers, keypad overlays and cameras will be recognizable to the typical ATM user." In particular, users should pay attention to the card reader and anything that protrudes from the machine, such as a mirror or pamphlet-holder—these are prime hiding places for tiny cameras. It can't hurt to give any of these items a quick tug to make sure they weren't lightly glued or taped into place. Another red flag: any machine in a row of ATMs that looks different from the others.

And always do your best to conceal your fingers as you type the PIN (try holding your other hand over the one typing). That way, even if there is a hidden camera, it will have a hard time capturing your PIN.

## A Better YouTube

**I heard that YouTube offers high-quality versions of its videos. How can I access them?**

YouTube videos may look fine in their tiny default video player, but blow one up to full-screen and it's apt to look like an animated Jackson Pollock painting—a nearly indecipherable blob of pixels that, when you squint your eyes, sort of looks like a lip-syncing dorm-dweller.

For YouTube, this presents a problem. The company is facing tough competition from sites such as Hulu, which streams TV shows at a relatively high resolution. To fend off the competition, YouTube now offers higher-resolution streams of many of its videos. But finding them can be a bit tricky. Most newer YouTube videos load with an HQ button (it stands for "high-quality") on the bottom of the player. Clicking it bumps the video's resolution up from 320 x 240 to 480 x 360. But YouTube doesn't offer resolution-jumping buttons for much of its older catalogue—even though many of these videos are available in higher-quality versions.

But if YouTube has a high-quality version of a video on its servers, you can watch it—just add "&fmt=18" to the end of the low-quality video's URL. Cumber-some? Definitely. But it works a good deal of the time. You can also make the high-quality versions pop up by default. To do this, you need to log into YouTube, click Account Settings,

Playback Setup, and set the video to "Always play higher-quality video when it's available."

## Reposting Twitter

**I set up my Twitter account to automatically post my tweets as Facebook status updates. However, the flood of updates is annoying my friends. Is there any way to limit which tweets pop up in Facebook?**

Twitter's 140-characters-or-less microblogging platform has exploded in popularity in recent months, allowing anybody to keep tabs on the mundane details of the lives of friends and the famous. (Celebrities: They post meaningless tweets just like us!) But for Facebook users who are already updating their "status" with the always-fascinating details of their lives, posting similar information to Twitter can seem like overkill. That's why Twitter makes it easy to automatically feed your tweets to Facebook, where they can pop up as status updates. To do this, just install the Twitter application on your Facebook page (this can be done at <http://apps.facebook.com/twitter>).

To limit which tweets pop up on Facebook, you'll need to disable the Facebook Twitter application and instead load one called Selective Twitter Status (it can be found at <http://apps.facebook.com/selectivetwitter>). Now, the only tweets that will show up in Facebook are the ones that end with "#fb."

PM

### : tech term

#### DDoS\$ attack

(Distributed Denial of Dollars attack)  
Online transactions take time and money to process. By bombarding a target with thousands of tiny transactions, a hacker can cost his target serious cash. This happened recently when somebody from the embattled BitTorrent site The Pirate Bay orchestrated a barrage of minuscule deposits to the bank account of the law firm representing a rival industry group.



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# THIS IS MY JOB

## RIVER GUIDE

- > WALKER MACKAY
- > LOCATION: FREDONIA, ARIZ.
- > AGE: 32
- > YEARS ON JOB: 14

**1. Row Raft** Each Avon SuperPro raft holds four people plus a guide, who mans the craft through 68 rapids during the course of a trip. "The river does a lot of the work," Mackay says, "but it takes some learning to understand what it does." The raft—big enough to carry two '60s-era VW Beetles—is made of Hypalon, a superdurable synthetic rubber; its self-bailing floor keeps it stable.

**2. Oars** Mackay uses oars made of a glass/carbon/epoxy composite—the same stuff used in the aerospace industry—with plastic-coated aluminum blades. "Aluminum oars bend too easily, and I've found many broken wood blades below rapids," Mackay says.

**3. Dry Bags** These 30 x 14-inch neoprene-coated nylon bags keep gear, clothing and sleeping bags dry in any situation.

**4. Throw Rope** Rafts carry two 50-foot  $\frac{3}{8}$ -inch Sterling WaterLine floating rescue ropes.

**5. Ice Chest** Mackay's company designs its own coolers, which use blocks of ice to keep food at 39 F.

**6. Satellite Phone** Mackay uses two sat phones—with talk times ranging from 1 to 3 hours—for emergencies. "I've been part of three helicopter evacuations," he says. "The patients all recovered—knock on wood."

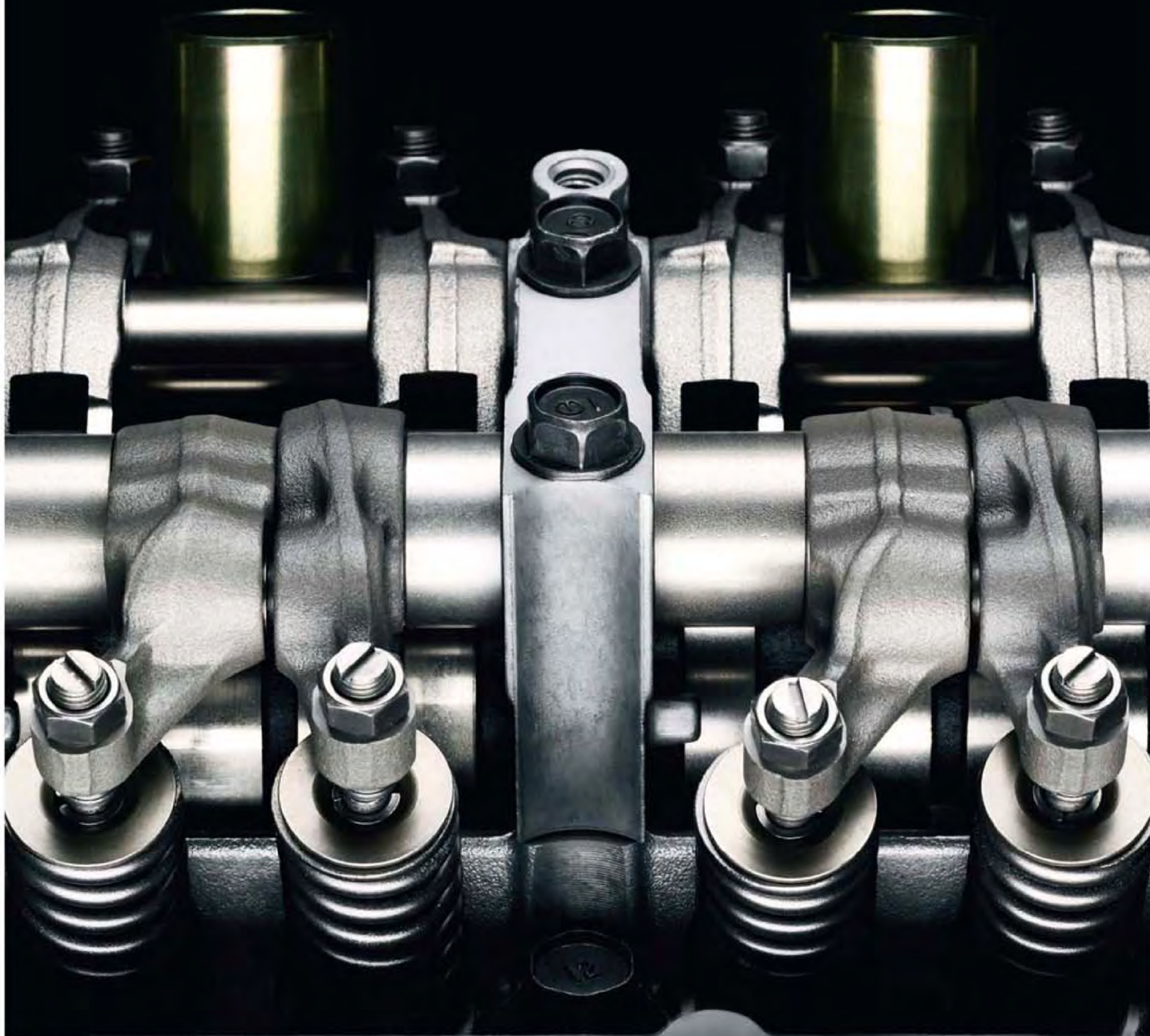


**Walker Mackay was only 8 years old** when he first ran the rapids of the Grand Canyon's Colorado River. Now 32, he leads 190-mile, 11-day journeys with the family business, Colorado River & Trail Expeditions. Mackay has seen everything from perfect runs to helicopter evacuations in the Colorado's rapids, which—because of the large volume of water—are rated on a 1 to 10 scale rather than the typical I to VI. But the best part of his job is helping people connect with their primal side. "The effect the Grand Canyon has on people amazes me," he says. "I can't tell you how many people say their rafting trip changed their life." — ERIN SCOTTBERG





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